SCIENTIFIC AMERICAN

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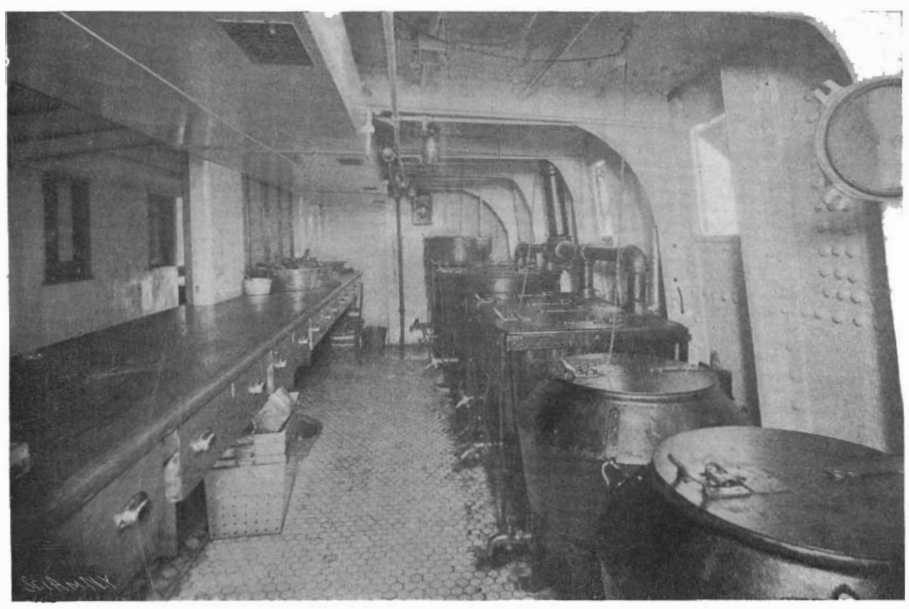
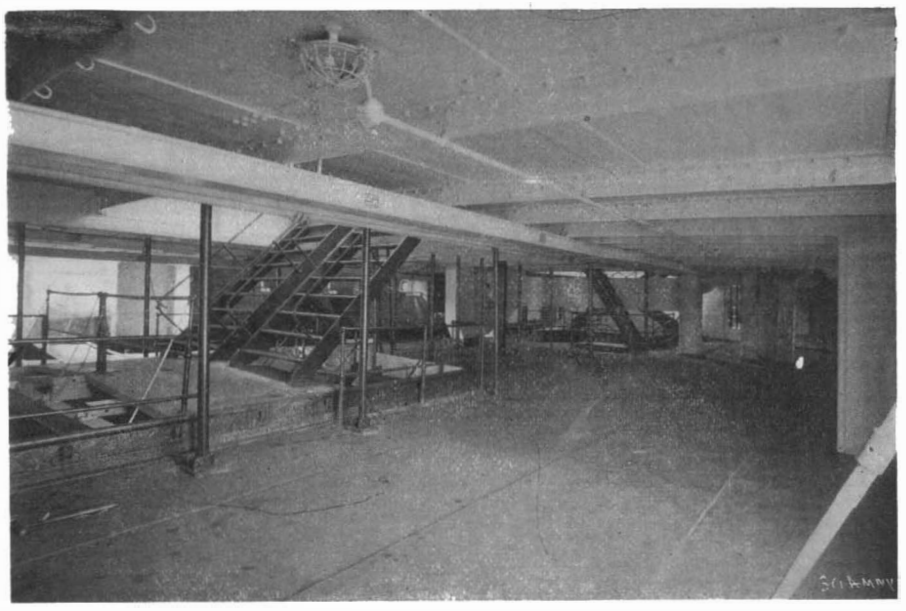
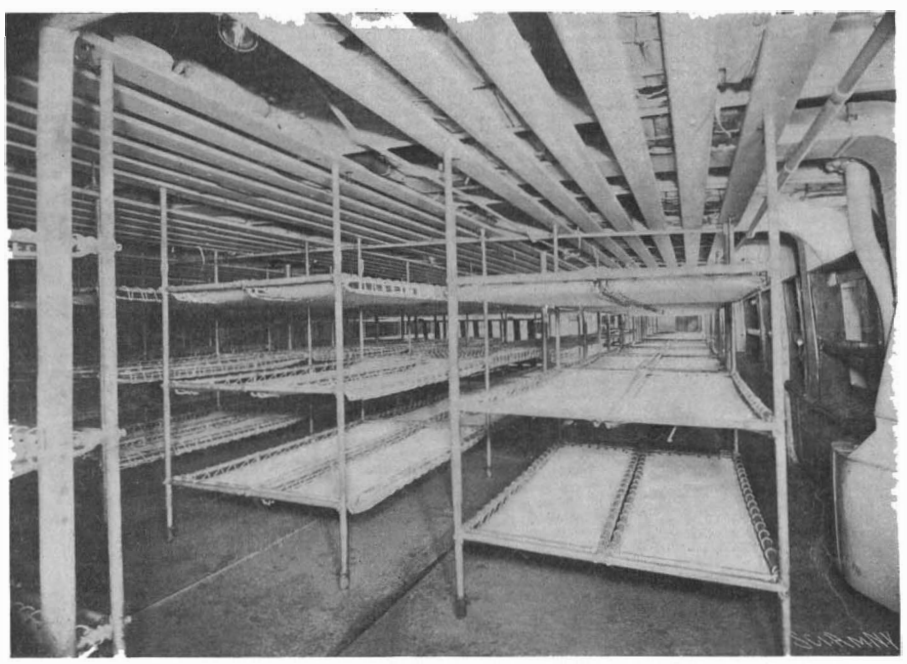


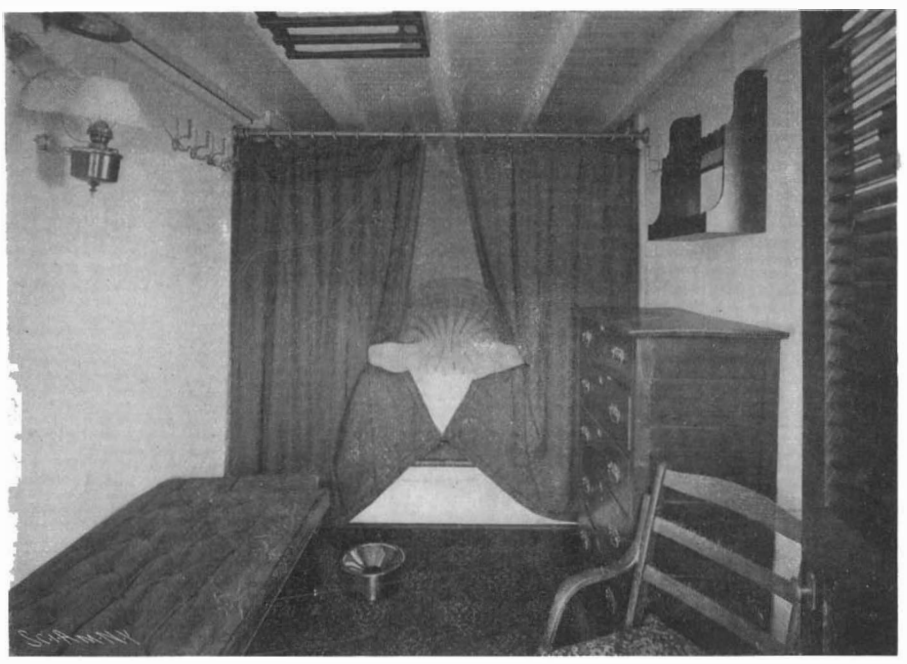
Kitchen with Steam Kettles.



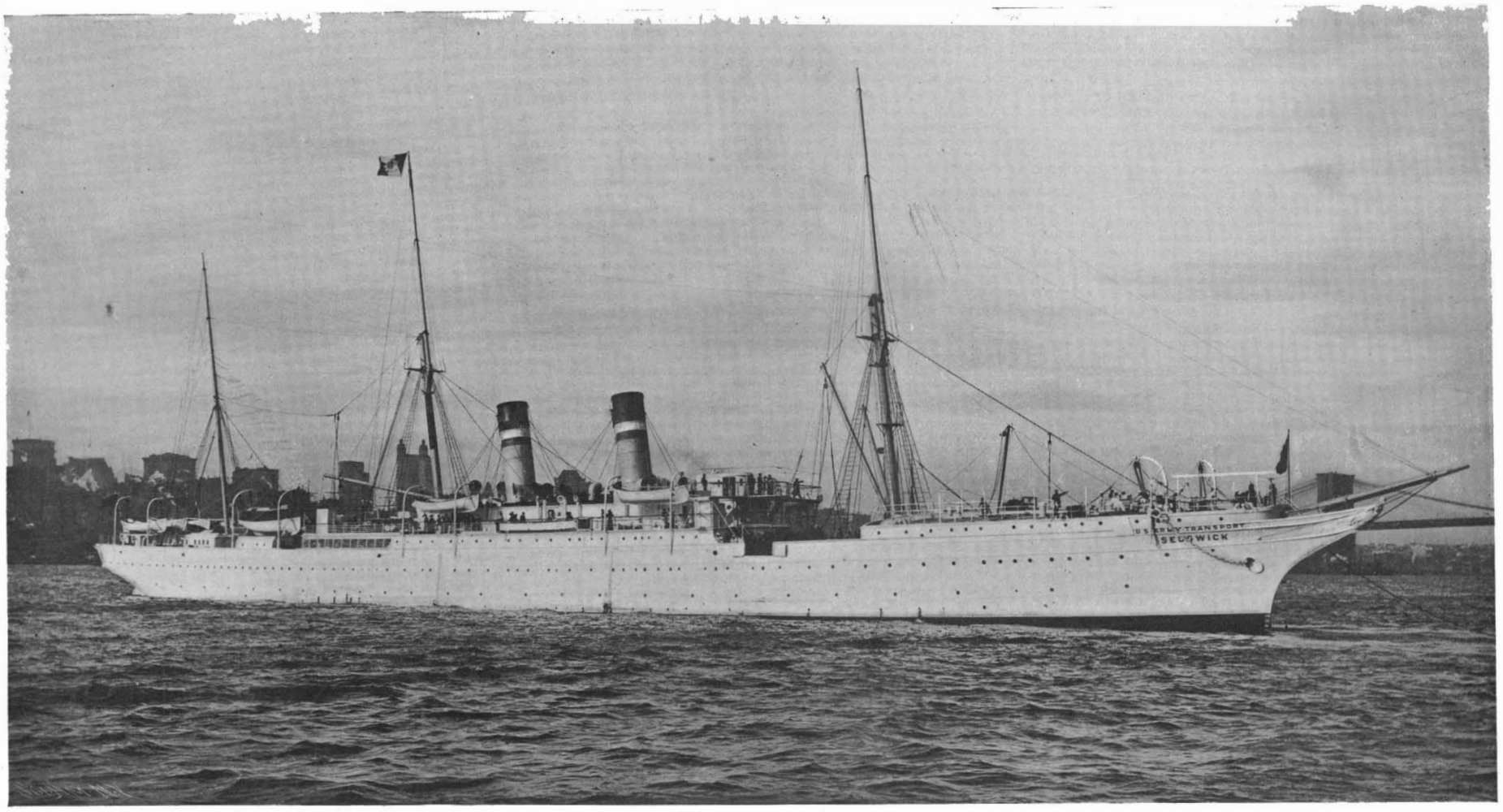
Mess Deck; Tables Cleared Away.



Sleeping Accommodation, Showing New Army Bunks.



An Officer's Room, Hurricane Deck.



Transport "Sedgwick," 4,770 Tons. Formerly "City of Chester." Carries 69 Officers, 1,000 Men, and 1,180 Tons of Freight.

ARMY TRANSPORT SERVICE TO THE PHILIPPINES.—[See page 182.]

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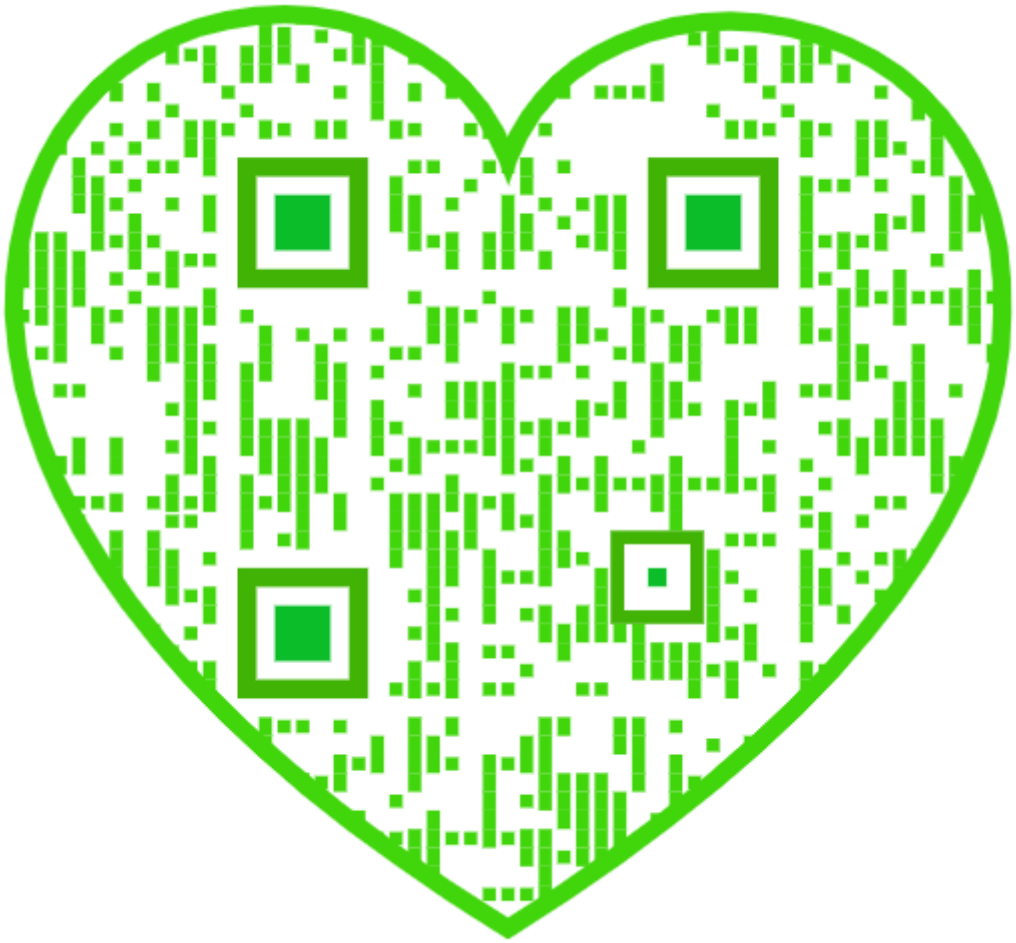

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NEW YORK, SATURDAY, MARCH 23, 1901.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

AMERICAN ENGINEERING PROGRESS.

During the spring of last year there appeared in The London Times a series of fourteen articles on the subject of American engineering competition, written by a special correspondent of that journal, who had made a tour of the principal industrial centers of the United States for the express purpose of comparing American industrial methods with those in vogue in Great Britain. This remarkable series, which was republished in consecutive numbers of the SCIENTIFIC AMERICAN SUPPLEMENT, commencing July 21, 1900, was evidently the work of a thoroughly qualified observer. It created a profound impression upon British manufacturers, the most advanced of whom were already familiar with the broad aspects of a question, which was here more explicitly discussed. The influence of these articles upon the British press, however, was to arouse a considerable amount of heated and antagonistic discussion, the consensus of opinion being that the articles were altogether too pessimistic in regard to the future prospects of British trade.

The author of the articles has recently commenced a second series, under the title, "American Engineering Progress," in which he undertakes to prove that his prediction of last year is already being fulfilled. The writer had predicted that the natural resources of the United States, the energy with which these resources had been developed, the splendid equipment of American steel works and the large scale upon which they were operated, would prove a menace to the British steel industry, whenever the slackening of the home demand in this country should leave a surplus product available for exportation. In the first article of this series, which will be found in full in the current issue of the SUPPLEMENT, The Times' correspondent states that there seems now to be dawning the period foretold, inasmuch as American makers are not only sending their surplus product to markets that are common both to themselves and Great Britain, but also are carrying the invasion into Great Britain itself. He quotes a Glasgow correspondent who, writing in November of last year, stated that steel rails continued to be very much depressed, since most of the export orders were being absorbed by American mills, at prices which British manufacturers could not at that time touch. At the same period, another correspondent, writing from Middlesbrough, stated that German manufacturers were offering plates at a price with which it was impossible for the home manufacturer to compete.

While it is admitted that the British steel makers are aware of the threatened attack upon their natural market, and that they are doubtless taking steps to meet the invasion, there is a strong disposition, chiefly on the part of the press, to look upon the matter simply as a spurt due to a temporary disturbance of the balance of trade, while there is a prevalent opinion in England that no country heavily protectionist in its settled policy can compete with free-trade in Great Britain. The writer admits that there is much to be said both for and against the latter view, but at the same time urges that no effort should be spared by Great Britain to develop her resources to the utmost and bring her blast furnaces and steel-making trades to the highest pitch of excellence reached in the United States, Germany, or elsewhere.

The Times' correspondent goes to the root of the matter when he says that a favorite method of avoiding the unpleasant admission that a very real crisis is at hand, is to point to the fact that the cry of calamity has been heard in England for the past three hundred years, one commentator on the articles on American engineering competition going back to the reign of Queen Elizabeth for a quotation to prove his point. In reply to these statements, it is pointed out that during the nineteenth century the development of the factory system, which in turn has been the result of mechanical invention, has caused the scepter of power to pass from the military to the commercial elements of the nation. A hundred years ago historians measured a country's success by battles won or lost, but to-day commercial supremacy is the first material essential to national greatness. Although it is still the "man behind the gun" who will decide the battle, the gun (and a very good gun, at that) must be there, and, for England, the ship to carry it, with all the marvelous complications of machinery that are essential to a modern fleet. It is pointed out that the racial characteristics which have enabled Great Britain to win battles are not necessarily those which furnish the best defense against commercial rivalry.

From this statement the argument passes naturally to a second and more important aspect, in which the present conditions differ from those of the past centuries; this being the increased extent to which other nations are competing with Great Britain in the markets of the world. Nothing like it has ever been seen before, and yet it is more true to day than ever before that England must make and sell, or starve. In that distant period of Queen Elizabeth to which one of the critics of The Times articles referred, the English might shut themselves up in their island and wait for a Spanish Armada, perfectly secure, provided the Spaniard could not gain a footing on their shores. Foreign trade was a small matter then. The country could live without it. So it was, though in a less degree, almost up to a time within the memory of men still living. Rapid interchanges of knowledge, no less than of commodities, however, have leveled distinctions, making the conditions of the race for commercial supremacy alike for all. Great Britain was the first in the field, with a long start in the race. For the greater part of the nineteenth century America was busy peopling her undeveloped territory; Germany, as we now know her, did not exist, and the other manufacturing countries seemed willing to concede to Great Britain the role she had allotted to herself as the "workshop of the world." By the end of the nineteenth century national commerce had become a ruling factor in the extended prosperity that has fallen to all nations; and it is only during a comparatively recent period that other countries have made a determined bid for the share which Great Britain has held in the world's manufacturing industries. It is this which differentiates the present from the previous periods, and gives to the present crises a significance all its own.

CURRENT OF 3,000 VOLTS AT THE MOTORS.

Electric traction on the Italian railroad systems is of special interest, as Italy is not a coal-producing country and fuel is consequently high in price; on the other hand, waterfalls are abundant, and it is quite natural the attention of the railroad companies has been turned toward the use of electricity for traction upon certain of their lines, now that the processes of transmission and utilization of energy have been well established. Among the most interesting projects is that of the Meridional Railroad Company, by which more than 60 miles of railroad are to be operated from a single generating station. For the first time a tension as high as 3,000 volts will be used directly for the motors. The projects of this company are about to be put in execution. The lines included in the system of electric traction undertaken by the Adriatic Company and Ganz & Company, of Budapest, extend to the north of Lecco toward Sondrio and Chiavenna, forming a system of roads which is almost independent of the rest of the system, and placed under conditions as regards traffic. These conditions are such that an important freight and passenger traffic will be developed. It has been necessary, in carrying out the project, to establish freight trains which are relatively heavy, and to separate entirely the freight and passenger systems. According to the project, the passenger trains are to weigh 65 tons, allowing 30 tons for the motor car; the speed will vary between 18 and 36 miles an hour, depending upon the grades, for which 300 horse power will be needed. The freight trains will run at 10 to 20 miles an hour, and the motor car will be able to draw 200 tons of load, the trains being made up of 15 to 20 cars. For the Valteline lines, forming a part of the system upon which will circulate five passenger and two freight trains at a time, the energy is estimated at 2,500 to 3,000 horse power. The road will be operated by a hydraulic plant near the station of Morhegno. A fall of about 100 feet will be utilized, and the water will be carried to the generating station by a tunnel nearly three miles long, cut through the rock. The station is to have three turbine-dynamo groups of 2,000 horse power each. The dynamos are of the three-phase type, of 1,500 kilowatts capacity, giving 15,000 volts. The road is fed by a trolley line, and the high tension wire is carried along the whole extent of the road upon the same posts (except in tunnels). By a series of sub stations located along the road at distances of 6 miles, the tension is reduced to 3,000 volts for the trolley wire. The system of trolley used is of a rather original type, and has been carefully designed to meet the requirements. Two trolley wires are used, and the current is taken into the car by two contact rollers, formed of aluminium cylinders of some length, rolling upon bearings carried by a boxwood shaft covered with insulating substance; the boxwood piece is supported from a heavy cast iron base on the roof of the car by means of a system of articulated bars and springs, so that the rollers are kept well in contact with the wires and can move readily in the vertical direction, while the system is otherwise quite rigid. The motor cars are of two patterns, for freight or passenger service. The former carry four motors of 125 to 250 horse power, being veritable locomotives; the latter have four motors of 75 to 150 horse power; only two of the motors work continuously, the two others being used when it is desired to obtain a greater tractive effort at the same speed. The trains are made up of a motor car and train of 65 tons, and the speed varies between 20 and 35 miles an hour. The trains are electrically lighted, heated and ventilated.

CONSTRUCTION OF THE SIMPLON TUNNEL.

The Simplon Tunnel, whose construction is being actively carried on, will considerably shorten the route from London and Paris to the Suez Canal; the distance from Calais to Milan, which is now 657 miles by the Mont Cenis, and 642 by the St. Gothard, will be only 565 miles by the Simplon. The Ostend-Milan will also be shortened by 57 miles over the distance via the St. Gothard. The agreement for the establishment of a tunnel across the Simplon, from Brigue to Isella, was signed on November 25, 1895, by the Swiss and Italian governments; this agreement gave to the Swiss company of the Jura-Simplon a concession for the construction and operation of the new line. The contract for piercing the tunnel was awarded to Brandt, Brandau & Company, of Hamburg. In reality, the construction includes two tunnels of single track, parallel, and having their axes 52.4 feet distant, uniting near the middle of the course into a single tunnel of 1,230 feet length, of double track, in which the crossings will be made. The first of these tunnels was to be completed in the space of six years, while the second will be taken up only when the traffic of the line exceeds a certain tonnage. The work was commenced August 15, 1898, and there seems to be little doubt that it will be finished within the specified time, or the middle of 1904.

The method of construction employed consists in piercing a gallery for each tunnel; these being united every 600 feet by transverse galleries. The gallery of the first tunnel is then enlarged to the normal section; while the enlargement of the second is reserved for a later period; it is, however, utilized at present for the arrival of the cars, which after being loaded leave by the first gallery, as well as for the evacuation of the water and for ventilation; the latter is carried out on a large scale by two 500 horse power ventilators, operated by turbines, which force the air into the second gallery and it comes out by the first. The ventilators will furnish 1850 cubic feet of air per second, at the pressure of 20 inches of water, which is necessary to drive the air to the extremity of the work. Except the last two, all the transverse galleries are stopped up so that the fresh air arrives to the first gallery at a point near the end. The front of the work proper is, however, outside of the sphere of air-circulation, and a special conduit has been installed which brings 20 to 30 cubic feet per second, kept at a temperature of 8 to 10 degrees C. below that of the walls by a system of water sprinklers. At the maximum working, these may absorb 15 gallons per second. The motive power used in the construction is furnished by the Rhone; a dam has been established at 2½ miles above the entrance of the tunnel, and the water is brought to a hydraulic plant which utilizes a fall of 1,250 feet and a maximum supply of 200 cubic feet of water per second. The turbines are thus furnished with an effective force of 2,230 horse power, which is well above the figure determined for the needs of the boring, ventilation, etc. This plant suffices for the northern entry of the tunnel, and for the southern entry a second plant has been established, utilizing the water of the Diveria, which gives a fall of about 500 feet with a minimum supply of 40 cubic feet per second, representing 1,600 horse power. The following table gives some of the principal data of the tunnel, together with that of the three other main tunnels of the Alps.

	Mont Cenis.	Saint Gothard.	Arlberg.	Simplon.
	Feet.	Feet.	Feet.	Feet
Length of tunnel.....	42,140	49,130	32,590	61,715
Maximum altitude of tunnel.....	4,273	3,795	4,323	2,326
Maximum altitude of the mountain along axis of tunnel.....	9,735	9,438	6,699	9,372
	Degrees C.	Degrees C	Degrees C.	Degrees C.
Interior temperature. . .	29.5°	30.8°	18.5°	40°

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At the end of August, 1900, the length of the working galleries was 11,050 feet for the north end of the tunnel, and 8,130 feet for the south end, or a total of 19,180 feet. The maximum force of workmen employed simultaneously on the two sections has been 1,073. The mean progress of the drilling has been 12.2 feet per day; up to the present only three drills have been used in each section. At 6,000 feet distance from the entry, the temperature of the walls has been found to be 20.4 degrees C. for the north section and 28.4 degrees for the south. The ventilation has absorbed daily, since the month of May, 52,984,000 cubic feet of air, of which 27,400,000 were for the north and 25,584,000 for the south end. The ventilators are as yet established only on the southern section; on the north section the air supply is obtained for the present by a ventilating shaft which is heated to increase the draught. The water-sprinkling devices are installed in each of the sections; the temperature of the water coming out of these is 20 degrees and 15 degrees C. for the north and south ends respectively, when it is but 10 degrees at the exterior. The volume of water under pressure which is sent to the extremities of each section amounts to 703 cubic feet for the north end and 592 for the south. For the north section, the mean daily consumption of dynamite is 1,110 pounds, being 596 pounds for the mechanical drilling and 594 pounds for the hand drilling; for the other section this consumption is 893 pounds, with 620 pounds for the mechanical drills.

THREE IMPORTANT PATENT DECISIONS BY THE UNITED STATES COURT OF APPEALS AT NEW YORK.

The United States Court of Appeals for the Second Circuit last week handed down its decision in the suit of the Thomson-Houston Company against The Lorain Steel Company for alleged infringement of Letters Patent to Walter H. Knight, No. 428,160, for electric motor regulators, commonly known as the "Interlock" patent. The complainant in this suit contended that this patent covered broadly the use of a stop or lock, controlled by the regulating switch of a motor controller, for preventing the operation of the reverse switch except when the regulating switch was at its off, or open circuit position; or in other words, that the patent covered all forms of the devices now in use in motor controllers which make it necessary for the motorman to operate his controller handle to shut off the trolley current before he can operate his reversing switch.

In an opinion by Judge Wallace, the Court of Appeals reverses the decision of the lower court, which held the defendants liable under the patent, and declares the patent to be invalid as to all the claims involved in the suit. Judge Wallace decided:

"The patent cannot be broader than the real invention, and that is measured by the novelty of the particular contrivances which constitute the locking mechanism. . . . We are of the opinion that the broad claims of the patent (claims 1, 2, 3 and 4) are not warranted by the scope of the real invention by Knight. As it is not asserted by the complainant that infringement of the fifth claim has been established, it is unnecessary to advert to the differences between the devices employed by the defendant and the patented devices. We conclude that the first four claims of the patent are invalid, and in the absence of any proof of infringement by the defendant of the fifth claim, the Court below should have dismissed complainant's bill with costs."

The same Court has also handed down its decisions in the suit of the Thomson-Houston Electric Company vs. The Nassau R. R. Company and The Lorain Steel Company, and in the suit of the Thomson-Houston Electric Company vs. The Bullock Company, et al. These two suits, which were heard together on appeal from the Circuit Court, and in which The Lorain Steel Company was the real party defendant, involved two Letters Patent to Elihu Thomson, Nos. 283,167, of August 14, 1883, and No. 401,085, of April 9, 1889, commonly known as the "magnetic blow-out" patent, the suits being for alleged infringement by the defendant in the manufacture, use and sale of its motor controllers.

The earlier Thomson patent was framed to cover broadly the application of a magnet to an electric switch for the purpose of extinguishing arcs formed at the switch contacts. In the opinion by Judge Shipman, the Court affirms the decision of Judge Thomas in the Circuit Court, and declares the patent to be devoid of patentable novelty in view of the prior art.

The later Thomson patent involved the use of insulating material in an arc-rupturing device for the purpose of protecting the metal surfaces of the switch contacts or electrodes and of the blow-out magnet from the action of the electric arcs.

The Court of Appeals reverses the decision below which sustained the patent, and declares it invalid. The Court says:

"We cannot perceive that the effect of the insulation in an arc-rupturing d[illegible] as anything more than the old effect which had always accompanied insulation."

These decisions of the Court of Appeals dispose of three patents claiming principles which lie at the foundation of the manufacture of the modern electric car controller, and terminate the protracted litigation which has been carried on under the patents against the controllers manufactured by The Lorain Steel Company.

THE GLASGOW EXHIBITION OF 1901.

The buildings to accommodate the exhibits at the great exhibition at Glasgow this year are rapidly approaching completion. Difficulty was experienced a short time ago regarding the delivery of the structural steel, but the trouble was avoided by eliminating a good deal of the steel work from the buildings. The designs for the buildings have been prepared by Mr. James Miller, I.A., of Glasgow. There will be four principal groups of buildings—the fine arts gallery, the machinery hall, the industrial section and the grand hall for entertainments—which will cover in all about 20 acres.

The buildings for the industrial section are in the Spanish Renaissance style. The building is 700 feet in length by 360 feet in width, and is crowned by a huge dome 80 feet in diameter, which is a conspicuous feature. The main avenue, 92 feet in width and 150 feet in height, extends longitudinally through this building, and has a massive circular arched roof. Four white towers spring from the building to a height of 180 feet above ground level. Round the exterior of the dome at a height of 100 feet above the ground is a large balcony which affords an excellent view of the whole of the grounds. Each corner of the building and the north and south fronts toward the center have a pavilion about 35 feet square, and surmounted with minarets, so that from the exterior the erection will present an attractive appearance.

The machinery hall is 500 feet in length by 320 feet broad, and consists of one central bay 100 feet wide, and four other bays each 53 feet in width. The height of the central span is 41 feet and that of the side spans 29 feet. The central bay is flanked on each side by an overhead gallery, 15 feet wide, from which the whole of the exhibits in the building may be witnessed. A railway is to be run into the hall for the conveyance of the goods, while a special footway is to be provided for passengers. The building together with the boiler house and goods yard covers 5½ acres.

The exhibition buildings will cost in all, with the exception of the magnificent new art galleries, $650,000. The art galleries, in which are to be placed the art treasures of the city, it is estimated will cost $1,250,000.

The exhibits are to be divided into eight classes, and all the leading countries of the world in addition to the British Colonies will be fully represented. The executive is desirous of making the section devoted to industrial design and manufacture specially exhaustive and adequate, and to attain this object deputations have been dispatched to the leading industrial centers to obtain the support of the most prominent manufacturers. Another important class is that devoted to machinery, electricity, motive power, and labor-saving appliances, which it is intended to make the most salient feature of the exhibition. The exhibits are to be driven by electric motors, and every assistance is to be extended to exhibitors in order that they shall be able to display the characteristics of their specialties to the best advantage. In the marine engineering and shipbuilding section will be exhibited a collection of models, representing the evolution of the modern ship from wood to iron, sail to steam, paddle to screw, and single engines to triple-expansion engines. In the locomotion and transportation section, the latest development of automobilism will be extensively represented, together with the most modern railway engines. Other sections include agricultural and mining machinery, scientific instruments, archæology, etc., while a special class is to be reserved for women.

During the time the exhibition is open scientific meetings will be held. The British Association will celebrate their annual gathering here, under the presidency of Prof. Rucker, the savant of terrestial magnetism. The Society of Engineers and Shipbuilders, the Society of Chemical Industries, and several other similar scientific and mechanical institutions will also contribute lectures dealing with their respective ramifications of industry and commerce.

RESIGNATION OF COMMISSIONER DUELL.

We regret to note that the Hon. C. H. Duell, Commissioner of Patents, has resigned the Commissionership to resume patent practice. Mr. Duell has been a most efficient executive officer of the Patent Office, and he will retire to private life with the best wishes of those who have been associated professionally with him.

SCIENCE NOTES.

A bust of Gauss is to be placed in the lecture room for geodesy and mathematics at the University of Berlin.

Dr. Talamon, one of the physicians of the Bichat Hospital, Paris, announces the successful treatment of pneumonia by injecting anti-diphtheritic serum.

A party from the Massachusetts Institute of Technology has perfected plans for going to the island of Sumatra to observe the total solar eclipse of the sun on May 17, 1901. The party will be in the charge of Prof. Alfred E. Burton.

A relief expedition sent by the Duke of Abruzzi left Sandefjord March 5 on board the "Capella." It is commanded by Capt. Stockken, father of the missing machinist of that name. The "Capella" will go to Franz Josef Land. They hope to find alive the Norwegian machinist and the two Italians who were lost in the recent Abruzzi expedition.

Prof. Loeb's experiments in artificial parthenogenesis are most interesting. He has been able to develop eggs of Chaetopterus, an annelid, into free-swimming larvæ by placing them in solutions which cause them to lose water. Potassium chloride solutions and hydrochloric acid when added to the sea water have been found effective in causing the eggs to develop. The artificially developed larvæ did not differ from those produced by natural fertilization, and it was concluded that the processes of segmentation are a function of the constitution of sea-water.

A London journal calls attention to what might be termed the "elevator disease." It says it looks as though people with weak hearts had, after all, better climb ten flights of stairs than effect the ascent by means of the elevator. Lift attendants have died sudden deaths; people with weak hearts have noticed ominous sensations when in the elevator. We are told the sudden transition from the heavier air at the foot to the lighter air at the top is extremely trying to the constitution. Most people have experienced singular sensations of internal collapse when the lift floor sinks beneath the feet, but none suspected that the results might be so serious.

A great congress is to be held in London on July 22 of this year on the subject of tuberculosis, and the discussion of the experiences obtained in various countries for the cure of consumption and the best methods to adopt to bring about its eradication. The congress will last five days, and it will be supported by delegates from all parts of the world, who will advance any information relative to the subject at their command. The King of England, who has always taken a keen interest in the cure of this malady, will open the congress. One of the leading features will be a museum containing a number of pathological and bacteriological instruments, charts, models, etc.

Prof. Pickering makes the following statement relative to the light flash from Mars: "Early in December we received from the Lowell Observatory in Arizona a telegram that a shaft of light had been seen to project from Mars (the Lowell Observatory makes a specialty of Mars) lasting seventy minutes. I wired these facts to Europe and sent out neostyle copies through this country. The observer there is a careful, reliable man and there is no reason to doubt that the light existed. It was given as from a well-known geographical point of Mars. That was all. Now the story has gone the world over. In Europe it is stated that I have been in communication with Mars, and all sorts of exaggerations have sprung up. Whatever the light was, we have no means of knowing. Whether it had intelligence or not, no one can say. It is absolutely inexplicable."

Vacant lots have been successfully cultivated in Philadelphia under the direction of the Philadelphia Vacant Lots Cultivation Association. During the past years gardens were provided for 480 families, consisting of 2,486 persons. The aggregate receipts from the various farms showed a total of $24,560. This is six times the amount expended by the association on the lands. Five families became so adept at gardening that their savings have enabled them to hire ample farms of their own. Thirteen families were given Belgian hares for experiment last year, and the successful results attained will cause the association to take up this line of industry on the farms this year.

Dr. George G. Hopkins, of Brooklyn, has been using decomposed light in the treatment of consumption with considerable success. Dr. Hopkins' system is to use decomposed light as a substitute for sun rays. The patient is fed with arsenic, cod liver oil, etc., in order to build up the system and strengthen the tissues. Then the light, which restores vitality, is used and the patient is enabled to throw off the germs of consumption. The system originated with Dr. Finsen, of Copenhagen. It has also been used for the treatment of cancer. A 15,000-candle power arc light is used and the light is decomposed by blue glass, thus allowing only certain of the rays to strike the patient.

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PRODUCTION OF PHOSPHORUS AND CHLORIDES OF CARBON BY MEANS OF ELECTRIC FURNACES.

That phosphorus can be extracted from the raw and unmixed phosphate rock is demonstrated by Dr. F. J. Machalske, a chemist of Long Island City, N. Y., who has constructed for the Anglo-American Chemical Company, of same place, two electric furnaces, condensers, etc., for the manufacture of yellow phosphorus from phosphate rock, by means of the intense heat of an electric arc. Our diagram represents in section the details of the electric furnace for the production of phosphorus, and our first engraving shows two such furnaces in operation. Each furnace has a chamber, 36 inches by 12 inches in area and 18 inches high, consisting of carbon crucibles, lined with calcined magnesia and a special mixture, and covered with fire clay and red bricks and a mixture of asbestos flour and borax.

Each furnace has on top an apparatus for feeding the rock into the chamber; an apparatus for holding an electrode 8 feet long and 4 inches in diameter.

The bottom and top electrodes are connected with numerous special electrical appliances, and by means of six cables, each 1,500,000 C. M., with two large transformers, as shown in our engraving, which are made by Wagner's Electric Manufacturing Company, and are similar to those furnished by this company for the calcium-carbide plant at Niagara Falls, N. Y. Each transformer is of 2,000 amperes capacity, and provided with a double-pole double-throw switch, and an apparatus for regulating the electric arc and heat in the furnace at 32 steps, ranging from 30 volts by 4,000 amperes to 120 volts by 1,000 amperes, alternating current.

Current for the plant is furnished from the circuits of the New York and Queens Electric Light and Power Company of Long Island City. When the current is turned on, in five minutes a temperature of about 7,000 deg. is produced, which smelts in fifteen minutes 150 pounds of Tennessee phosphate rock, consisting chiefly of calcium phosphate, which is split up into its component parts, setting free vapors of phosphorus, which are condensed under water, and the residual slag, being in a very hot, sirupy state, is allowed to run off as shown in our engraving.

The extraction of phosphorus is, so to speak, a complete one, as the residue of phosphorus in the slag does not exceed one per cent. The operation is a continuous one, and the arc can be drawn to 15 inches. The condensed vapors of phosphorus collect in condenser mostly in the shape of dark yellow colored cork shavings, which, after being taken out of the condensers and treated with sodium-hypobromide, as same possesses the property of reducing the red phosphorus and removing the impurities, without affecting yellow phosphorus, are shaped, in usual manner, into nearly white, glassy and transparent sticks.

It is claimed that yellow phosphorus may be produced by this method at a rate of seven cents per pound, inclusive of the cost of electric power at three cents per horse-power hour, and phosphorus produced at such a rate is a very cheap raw material for the production of phosphoric acid. The production of chlorides of carbon by means of electric furnaces has been the subject of experiments by Dr. F. J. Machalske, and it is stated that by treating in such a furnace a mixture composed of salt, carbon, and sand, and condensing the vapors, there is obtained a colorless liquid of pleasant odor, specific gravity 1.6, and boiling point at 172 deg. F. It may be solidified at 9 deg. F. This liquid is carbon tetrachloride, much heavier than water, uninflammable, and possessing higher grease-dissolving properties than those of naphtha; and as it can be produced at a low cost, it is expected that

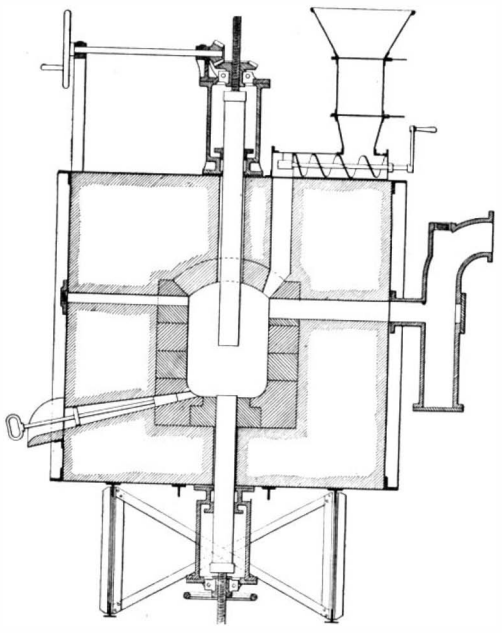
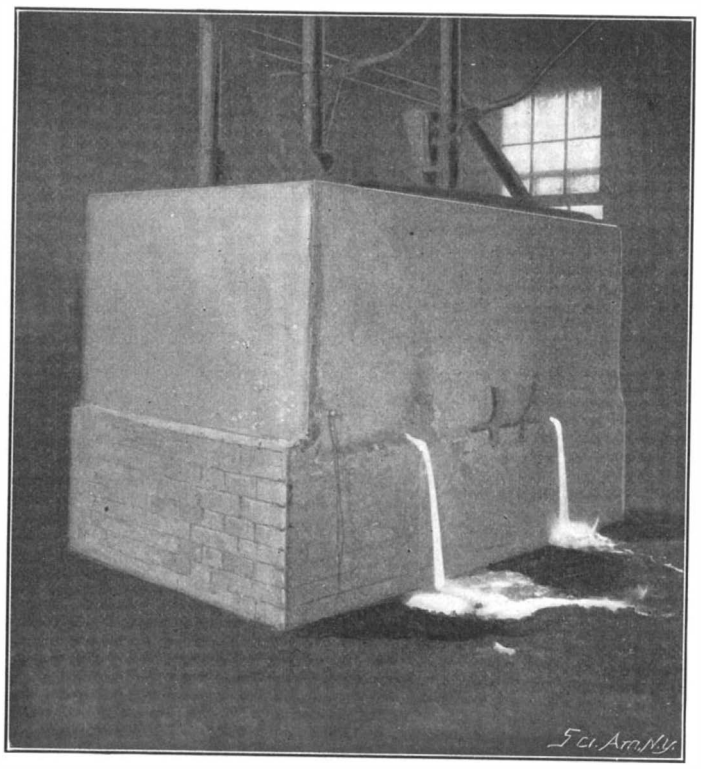


DIAGRAM OF ELECTRIC FURNACE.

carbon tetrachloride will find an extensive application in the extraction of oils, greases, etc.

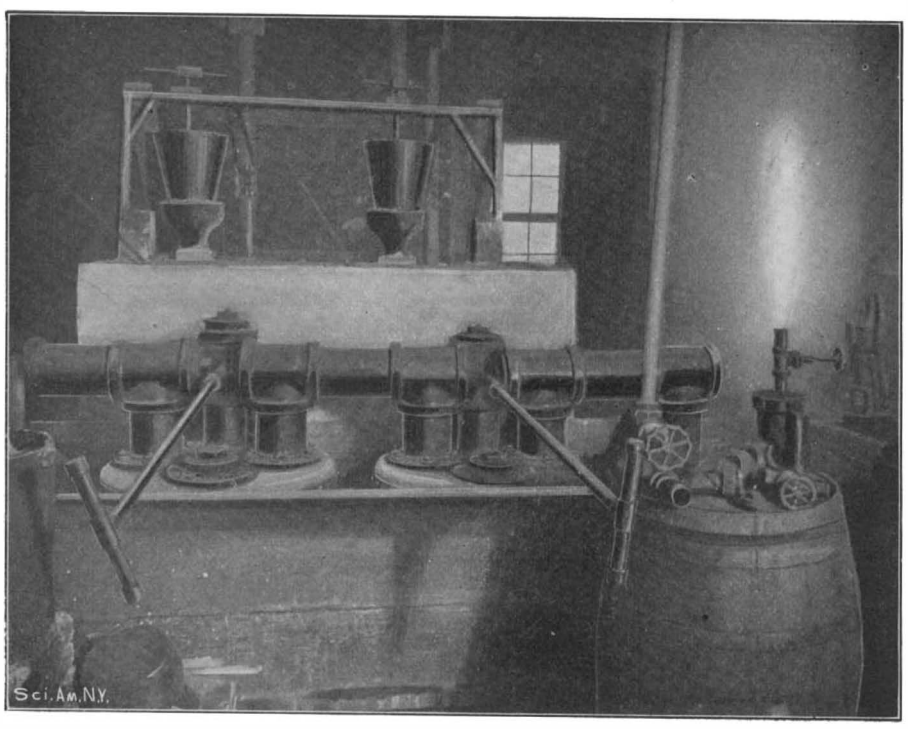
Recent Experiments on the Passive State of Metals.

The passive state of metals is the subject of an interesting paper read by Prof. Hittorf before the German Electro-Chemical Society at its recent meeting in Zurich. It is known that some of the metals, especially iron, assume in some cases an inactive state in which they acquire singular properties, and remain unattacked by many reagents which are usually capable of combining with them. The author wishes to show that this passive state is not due to a thin layer of oxide upon the surface, as has been commonly supposed heretofore. He carries on a series of parallel experiments with iron and chromium, owing to the close analogy of the two metals. A striking example of the passive state is found when one of the metals forms the anode in a certain electrolyte, when the electromotive force set up at first quickly diminishes and as the metal assumes the passive state is reduced almost to zero, coming back to its former value when the circuit is opened. In a series of experiments, Prof. Hittorf forms a chromium-platinum couple, the chromium being surrounded by a solution of sodium chloride or nitrate, and the platinum by a depolarizer of dissolved chromic acid. Under these conditions, the electromotive force diminishes more quickly as the current is stronger—that is, when the resistance of the circuit is less. In the case of iron, like results are obtained, but not with the halogen salts (except the cyanides); by putting in circuit a galvanometer of small resistance, the deviation becomes smaller, and is finally almost zero, but upon opening the circuit the electromotive force increases, and at the end of half an hour it returns to its former value. The iron retains all the while its metallic luster, and its weight is invariable. If left on short circuit for a long time, even for days, the iron still remains bright and unattacked; in this case the return to the normal is slower. This action is found, in the case of iron, with nitrates, chromates, acetates, etc., but not with sulphates. It will be noted that the metal returns spontaneously to the active state, and this fact cannot be reconciled to the formation of a layer of oxide, for the latter being insoluble and not volatile, the passive state should continue. The experimenter shows, besides, that iron oxidized by heat is not really in the passive state, as it gives, under the above conditions, about the same electromotive force at first as the polished metal. It is found that analogous metals, nickel and cobalt, also assume the passive state, but the action is less marked. Prof Hittorf intends shortly to publish a series of interesting results obtained with silver, lead, etc. If silver is taken as an anode in a sulphate of soda solution, upon closing the circuit there is at first produced a cloud due to the formation of sulphate of silver; this formation diminishes, and then ceases altogether. If the silver is now removed to another place free from the cloud, it is remarkable that it ceases to form any more sulphate, but after a time becomes black, and by combining with oxygen forms peroxide; after the silver is covered with the peroxide, the oxygen forms bubbles upon the surface. Lead has an analogous action in a solution of sulphuric acid.

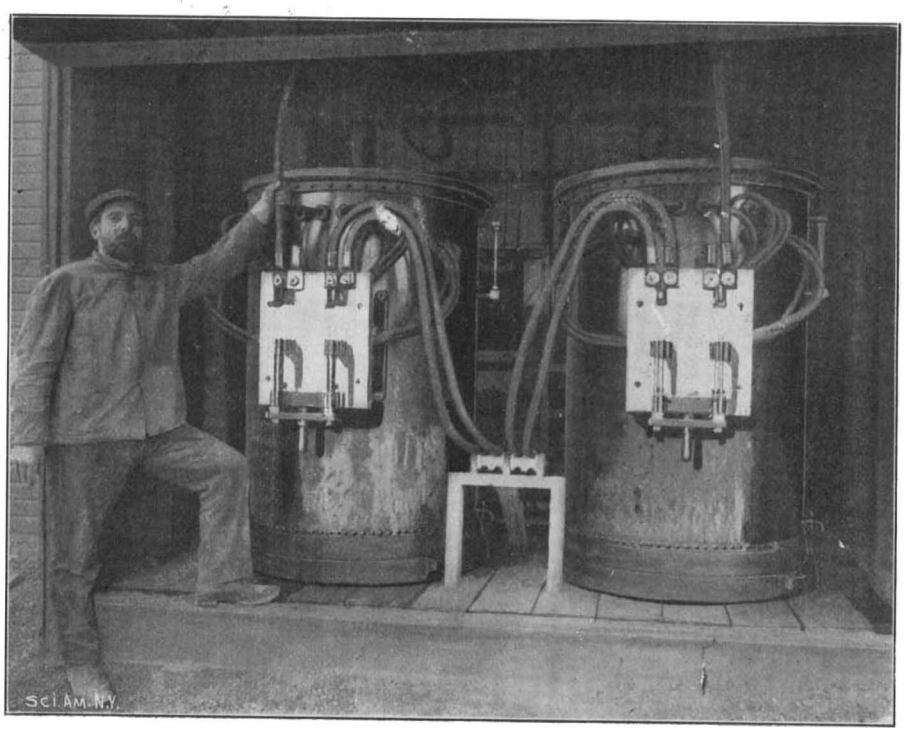


FURNACES BEING DISCHARGED AFTER EXTRACTION OF PHOSPHORUS.

The Philippine Commission has amended the Harbor bill by appropriating an additional $1,000,000 immediately, subject to the approval of the Governor General. This amount is to be used for the extension of the breakwater and the dredging of the inner harbor to a depth of 30 feet, which will admit of the deepest ships coming right up to the bulkheads. The appropriation also provides for the deepening of the Pasig River to a depth of 18 feet. The bill of the Commission also authorizes the Chief Engineer to accept additional contracts amounting to about $2,000,000 in anticipation of appropriations by the American Congress for various improvements.



TWO ELECTRIC FURNACES IN OPERATION.



THE TRANSFORMERS AND SWITCHES.

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THE BURRY PAGE-PRINTING TELEGRAPH.

The development of the art of telegraphy has been marked by the production of some of the most ingenious machines to be found in the whole field of practical mechanics; and in no part of it has more well-applied inventive energy been displayed than in the direction of what might be broadly classified as telegraphic printing, or the automatic recording of messages by printing the same in the characters of the Roman alphabet.

Although the art of telegraphic printing had its beginning as long ago as the middle of the century, it is only during the past few years that successful attempts have been made to produce a true page-printing telegraph. The ingenious machine which forms the subject of the accompanying illustrations is a very successful attempt on the part of John Burry, of the New York News Bureau, 16 Broad Street, New York, the inventor and manufacturer both of this machine and of the well-known ticker which bears his name, to substitute a true page-printing telegraph in place of the old ticker with its messages written upon a continuous tape.

The objects aimed at in this invention may be broadly summed up under the following three heads:

First: To produce a machine that would receive a telegraphic message and print it in the Roman alphabet, not, as in the old "ticker," in a continuous line upon an endless strip of tape, but in presentable page form, suitable for commercial or domestic use.

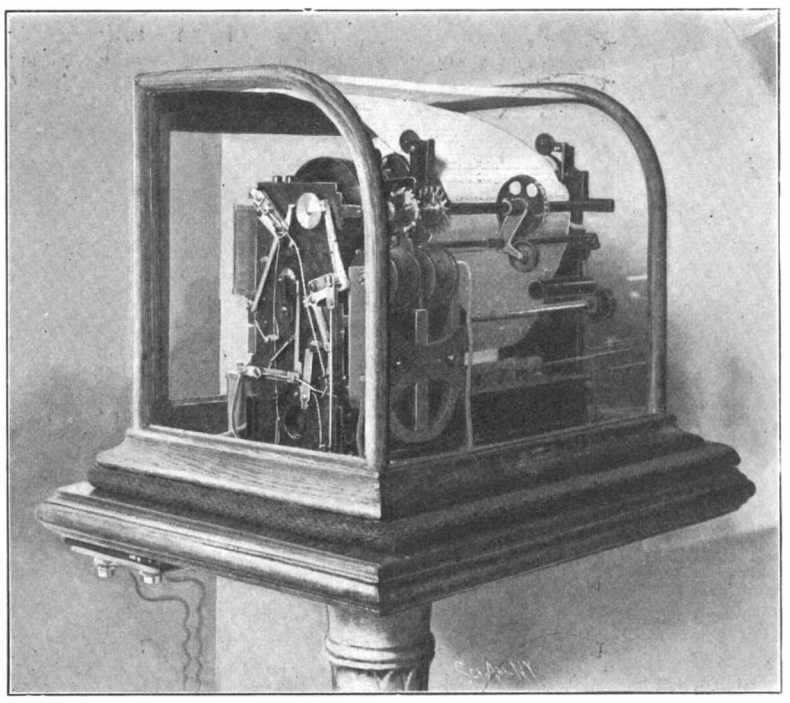
Second: To provide a machine which would be absolutely automatic, and, therefore, independent of both the sender and the receiver, thereby obviating all risk of clerical errors.

Third: To provide a system whereby a large number (several hundreds, if so desired) of these machines could be operated at one and the same time by a single sender at the central station.

Broadly stated, the system consists of a transmitting machine at the central station, from which, by the operating of a keyboard, certain electrical impulses are sent out, in the proper sequence and of the proper polarity, over two line wires, to any number of printing telegraphic machines. As each key of the transmitter is depressed at the transmitting station, electrical impulses are sent out through the circuits and act upon a series of magnets in each of the receiving instruments, the magnets serving to furnish the energy for the automatic movements of the machine.

The operation of the printing-telegraph, so far as its internal mechanical movements are concerned, is absolutely automatic, and hence, to all intents and purposes, the operator at the transmitting station, who may be some hundreds of miles distant from the printing telegraph, is able to print, without any possibility of error, a hundred different messages, in as many different and widely separated localities. We present a photographic view of the printing telegraph, as it appears when installed in a business office or any other place of use. It is mounted on an iron stand and inclosed in a glass case, as shown. As the roll of paper is printed it is delivered automatically at the back of the machine, and the printed matter may be cut off in pages of any desired length.

The relative position of the magnets in the electric circuit is shown clearly in the diagram (Fig. 2), and before entering into a detailed, consecutive description of the movements of the machine, it will be well to state briefly the particular operations which each magnet is designed to fulfill.



PAGE-PRINTING TELEGRAPH MOUNTED ON STAND.

The escapement magnet, *A*, controls the position of the escapement wheel, 2, and the type-wheel, 3.

The power magnet, *B*, has six functions:

(1) It turns the type-wheel forward or backward 1-72 part of a revolution at each pulsation;

(2) Winds the main spring, 4 (Fig. 5);

(3) Winds the traversing spring, 5 (Fig. 5);

(4) Controls the unison device, 6;

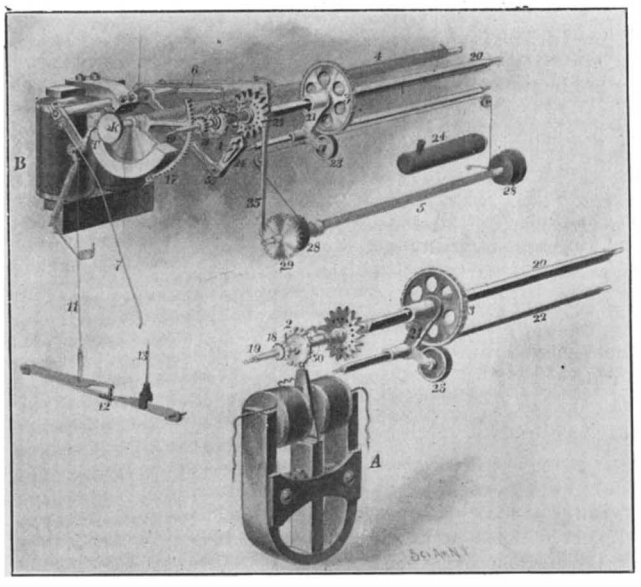


Fig. 5.—TYPEWHEEL POSITIONING MECHANISM AND ESCAPEMENT.

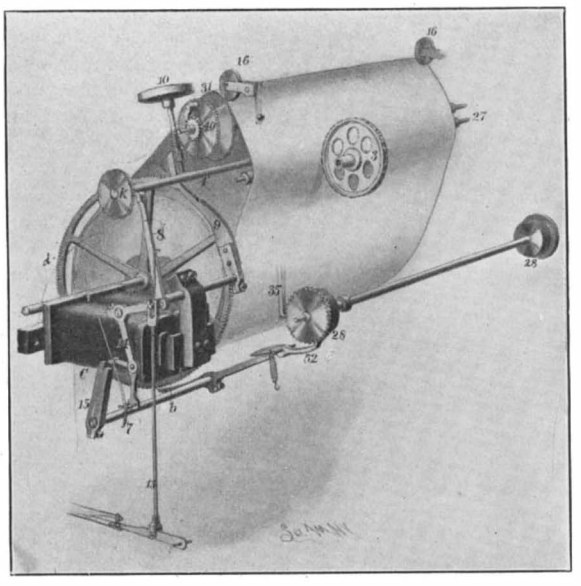


Fig. 3.—DETAILS OF PAPER FEED AND RELEASING GEAR.

(5) It gives oscillating movement to wire, 7 (Figs. 3 and 5), which throws pawl on arm 14 into engagement with arm 15 (Fig. 3);

(6) By means of a catgut, 11, it actuates one of the two contact points, 12; and acting in conjunction with the vertical rod, 13, operated by magnet, *C* (Fig. 3), it serves to cut in the current for magnet, *D*, whose duty it is to bring up the impression roller, 27 (Fig. 1), at the proper instant for printing a character.

The magnet, *C*, has four functions:

(1) By means of a pawl, 8, and ratchet wheel, *K*, it assists in winding up the main spring, 4 (Fig. 5).

(2) By means of arm, 9, it spins the shaft and flywheel, 10, and, through a worm on said shaft engaging a worm-wheel, 40, it winds up two helical feed-springs, which, acting on two toothed wheels, 31, one at each edge of the paper, serve to keep them under a constant tension.

(3) It operates the rod, 13, before referred to as assisting to cut in the current for magnet, *D*.

(4) It operates a lever, 14, whose lower end carries a pawl, which serves to engage the upper end of the arm, 15, for purposes later explained.

The purpose of the magnet, *D*, is to bring the impression roller, 27, forward at the proper instant for taking an impression from the type-wheel.

The quick-acting magnet, *E*, actuates a forked rod, 26, which forms part of a switching device, that throws the tooth, 24 (Fig. 1), to the right or left, and determines which of two adjacent letters on the type-wheel is to be thrown into the printing position.

The machine consists essentially of a base and two end frames, in which latter are journaled the various shafts and spindles, and upon which are carried the five magnets and the numerous pawls and levers, by which the various movements in the machine are performed. A roll of blank paper, 5½ inches in width, is carried upon a roller, with a steel center, journaled at about the midheight of the frame. It is maintained under a constant and even tension by means of two toothed wheels, 31 (Fig. 3), one at each edge of the paper, the paper being pressed down upon the serrated periphery of the wheels by two small pressure rollers, 16. The toothed wheels, 31, are maintained under constant tension by means of a winding gear, which is operated by the magnet, *C*, acting through arm, 9. As this arm oscillates, a knife edge on its upper end strikes a small pinion at the foot of the shaft, 10, on which is a flywheel, and causes it to spin, a worm above the pinion on said shaft engaging the worm wheel, 40, and winding up the shaft on which this worm-wheel is journaled. Upon the shaft, between the toothed wheels, 31, are two helical springs, which are wound upon the shaft with sufficient friction to cause the rotation of said shaft to exert a rotational effect upon said toothed wheels, 31, thus preserving a constant tension upon the paper. This tension is resisted by two pawls, *a* and *b* (Fig. 4), which engage a toothed wheel, *d*, keyed firmly upon the steel shaft that carries the roll of paper. The pawls, *a* and *b*, are operated by the pulsations of the magnet, *C*, and are brought into play whenever a new line is to be commenced, the releasing of the wheels allowing the paper to be unwound a quarter of an inch, which is the space between two successive lines. This escapement is provided with ingenious mechanism to compensate for the decreasing diameter of the roll of paper; for it is obviously necessary that the escapement wheel, *d*, should rotate through a larger arc, when the roll is nearly exhausted, than it does when the roll is full; otherwise an even feed of a quarter of an inch could not

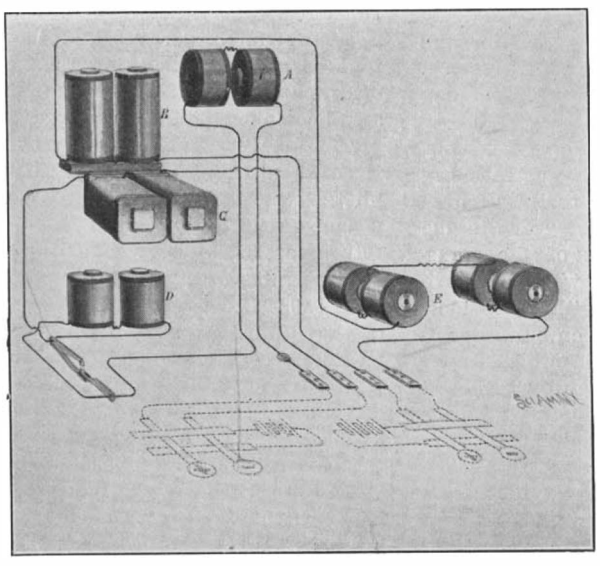


Fig. 2.—DIAGRAM OF ELECTRIC CIRCUIT.

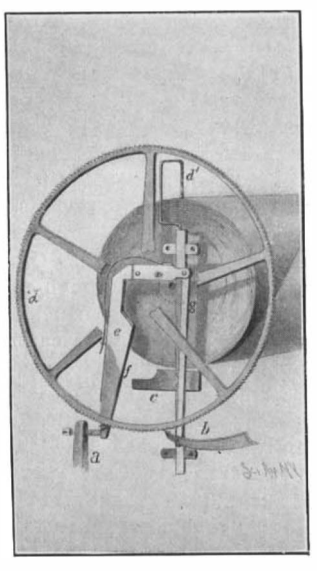


Fig. 4.—PAPER FEED.

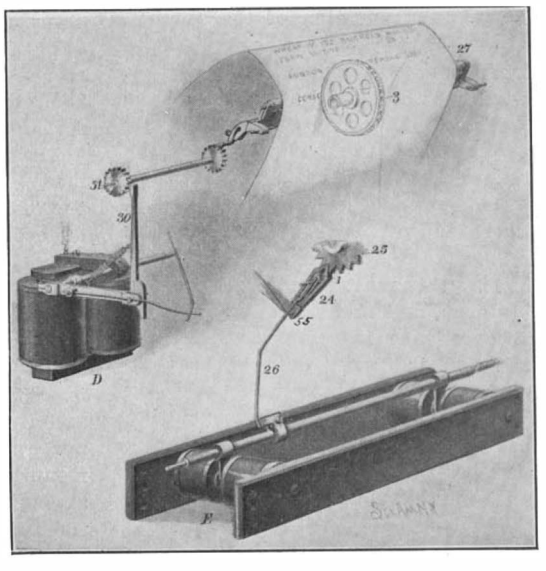


Fig. 1.—PRINTING MECHANISM AND OSCILLATING MOVEMENT.

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be maintained at all times. The compensating gear consists of a curved wire, *d'*, one end of which rests upon the roll of paper, while the other is attached to a vertical sliding bar, at the center of which is carried a horizontal stop-piece, *c*. When the paper is to be drawn forward, the stop, *b*, is released and the stop, *a*, engaged, the amount of rotation of the escapement wheel, *d*, being determined by the distance between the inclined face, *f*, of the arm, *e*, which carries the escapement pin, *a*, and the opposing face of the stop-piece, *c*. By this arrangement it will be seen that as the roll decreases, there is an equivalent increase in the amount of rotation of the escapement wheel, *d*, at each release.

Type-Wheel: The type-wheel is a small disk of brass with the alphabet cast in soft rubber around its periphery. This wheel is capable of rotation, oscillation and lateral or transverse motion, these movements being secured in the following manner: In the first place, there is a helical mainspring, 4, extending entirely across the machine, which is kept under tension by two pawls, *T* and 8, operated respectively by magnets, *B* and *C*, as already described. This mainspring is in frictional contact with the shaft on which the ratchet wheel, *K*, is keyed, and one end of it is attached to and actuates a gear wheel, 17 (Fig. 5), which in turn rotates the pinion, 18, and shaft, 19. The shaft, 19, is clutch-connected by coiled springs, 50, with a triangular shaft, 20, on which the type-wheels, 3, and carriage, 21, slide, and by which the type-wheel, 3, is rotated. The smaller triangular shaft, 22, just below serves as a guide, and is engaged by the lower elbow of the carriage. The ink roller, 23, is carried on an arm of the carriage, and is inked every time it passes the ink-brush of the ink tank, 24 (Fig. 5). Under the constant tension of the mainspring, 4, operating as described, the type-wheel tends to rotate in a constant direction, but is controlled by the escapement wheel, 2, which is operated by the magnet, *A*. The escapement is so arranged that a single pulsation of the magnet causes the type-wheel to rotate through the space of two letters. Thus, if the type-wheel is to be rotated through the space of six letters, there will be three pulsations of the magnet, *A*, three teeth of the escapement being allowed to pass. When this has occurred, the wheel is brought up in its *approximate* position, or midway between any two letters, and it is now necessary to move the type-wheel to the right or left just half a space, or 1-72 of a revolution, in order to bring the desired letter to the exact position for printing. This small movement is accomplished by means of the V-shaped, reciprocating, tooth, 24 (Fig. 1), which is controlled by a magnet, *E*. This tooth is pivoted at 55 (Fig. 5) on a rocking arm, whose movement is derived from the magnet, *B*, as shown in Fig. 5. The V-shaped tooth engages a star wheel, 25, which is carried on the same triangular shaft, 20, as the type-wheel. After the escapement has brought the type-wheel to the mid-position between two letters, the magnet, *E*, by means of the forked arm, 26, throws a small tongue, 1, to the right or left of a guide pin, placing it in such a position that, as the tooth, 24, comes up, its right or left-hand face will engage the star wheel, turning it 1-72 of a revolution to the right or left, according as the right or left-hand letter is to be brought into the printing position. The movements involved in these operations, acting by means of catgut, 11, and vertical rod, 13, on the contact points, 12 (Fig. 5), cut in the current for magnet, *D* (Fig. 1), which, by means of a pawl, 30, and ratchet wheel, 51, brings the impression roller, 27, forward and prints the letter on the paper.

The transverse motion of the type-wheel across the machine is accomplished by means of a cord (Fig. 5) which is attached at its center to the type-wheel carriage, 21, and extends parallel with the guide bar, 22, passes over two small pulleys at the end of this bar, and is wound at each end on two drums, 28. The drums are rotated by means of the ratchet wheel, 29, and the pawl, 35, at every pulsation of the magnet, *B*, each movement of the ratchet causing the type-wheel to travel transversely the space of one letter. The ratchet also winds up the helical spring, 5, on the shaft that carries the ratchet wheel and drums, and when it is desired to return the type-wheel for the commencement of a new line the pawl is automatically released, and the tension of the helical spring, 5, draws the type-wheel sharply back to the starting point, ready to commence the next line.

The printing done by this most ingenious little machine is remarkably even, and in its spacing and general typographical excellence it compares favorably with the best work that is turned out on the typewriter. We are informed that during the past six months over one hundred and fifty of these printing telegraphs have been put in operation in New York and Chicago, the number being limited by the capacity of the shop in which the machines are constructed.

In 1900 applications for patents in the United Kingdom amounted to 23,909. In the previous year the number was 25,775, showing a decrease.

TRANSPORT SERVICE TO THE PHILIPPINES.—I.

It is unfortunate that a certain branch of the War Department, whose duties are in many respects more perplexing, arduous, and, at times, heartbreaking, than those of any other branch, should be the least in the public eye, and be apt to receive the smallest amount of credit for its services. We refer to what is known as the Quartermaster's Department. The efficiency of an army has, in every age, been measured largely by the effectiveness of its methods of transportation; and the modern developments in the art of war have been such as to render the work of the Quartermaster's Department of greater importance than at any previous period. Never, surely, have armies depended more absolutely for their success upon an efficient system of transport than those which, during the past two years, have been engaged in the mountains and swamps of the Philippines and on the broad veldt and among the rugged kopjes of South Africa.

The Quartermaster's Department is not merely charged with the duty of providing means of transportation of every character, either under contract or in kind, which may be needed in the movement of troops and material of war, but it has a great variety of other duties, incidental to the equipment, housing and supplying of an army. It furnishes all public animals employed in the service of the army, the forage consumed by them, wagons and all articles necessary for their use, except the equipment of cavalry and artillery. It furnishes clothing, camp and garrison equipage, barracks, storehouses and other buildings; constructs and repairs roads, railways and bridges; builds and charters ships, boats, docks and wharves needed for military purposes; and attends to all matters connected with military operations which are not expressly assigned to some other bureau of the War Department.

Beyond being aware of the fact that we have a considerable army in the Philippines, which is recruited and furnished with supplies from this country, the general public has but little knowledge of the vast amount of labor and expense entailed in the mere transportation of troops and supplies to those far-off islands of the Pacific. It is a fact that at one period of the war the fleet of army transports numbered no less than seventy large ocean-going ships, this being the number engaged at the time when the volunteers were being brought home and the regular army carried out to Manila. As this work was completed the transports were gradually discharged from service, until, at the present time, the fleet consists of twenty-six transports owned by the department, and eleven vessels which are employed under charter, making a total of thirty-seven vessels. The magnitude of the operations of the Quartermaster's Department may be judged from the fact that during the past fiscal year transportation was furnished by rail, water, wagon and stage, exclusive of the Army Transport Service, for 747,399 persons, 18,455 animals, and 328,801 tons of freight; while the army transports carried 104,422 passengers, 13,397 animals, 310,683 tons of freight, and 2,523,836 packages.

The army transports range in size from the "Ingalls" of 1,147 tons, and a carrying capacity of 26 officers and 260 men, up to the "Grant" of 5,658 tons, and the "Sheridan" of 5,673 tons, the former with accommodation for 68 officers and 1,836 men, and the latter accommodating 93 officers and 1,843 men. Six of the transports are of from 5,000 to 6,000 tons, these being the "Grant," "Hancock," "Logan," "Meade," "Sheridan" and "Sherman;" three, the "Crook," "Sedgwick" and the "Warren," are of between 4,000 and 5,000 tons burden; six vessels, the "Buford," "Kilpatrick," "Lawton," "Relief," "Sumner" and "McPherson," measure from 3,000 to 4,000 tons burden; while five vessels, the "Burnside," "Egbert," "McClellan," "Rawlins" and "Rosecrans," are of from 2,000 to 3,000 tons. Of the chartered ships, two, the "Indiana" of 2,484 tons, and the "Pennsylvania" of 3,166 tons, are used as troop ships, while the other nine, which are vessels of from 3,500 to 5,000 tons displacement, are used for the transportation of horses and mules, and live stock. The chartered vessels cost from $650 to $700 per day for charter alone.

The army transports are fine, seaworthy vessels, many of which like the "Meade," which was formerly the "City of Berlin," had previous to their purchase done duty for a considerable number of years in the transatlantic passenger trade. Others of the transports were vessels that, although they were built primarily as freighters, were furnished with a considerable amount of accommodation carried on superstructure decks amidships. When a transport is purchased she is sent to a shipyard where she is carefully surveyed and a very comprehensive specification is drawn up for her refitting and renovation. The special requirements of the transport service necessitate a large amount of structural refitting, which, together with the furnishings and accommodations for officers and men, bring the cost of reconstruction to a very high figure. In the first place, the hold of the vessel must be adapted to carry the class of cargo required for army purposes, the hatches and holds being so rearranged that the stores necessary for the subsistence of from 1,000 to 1,500 officers and men, for seventy days, may be at all times accessible. This necessitates that about 175 tons of provisions be placed so that they can be drawn upon daily as required. Provision must be made for keeping a large amount of meat in storage; vegetables must be stored in special gratings under lock and key; and various other special fittings must be put in place. A complete system of ventilation has to be installed; for where such large numbers of men have to be confined between decks, much of the time in tropical climates, special appliances are necessary for drawing off the polluted air and supplying large volumes of fresh air. The ventilation usually consists of four fans carried on deck, which are capable of supplying from 75,000 to 100,000 cubic feet of air per minute. The air is delivered to fore and aft lines of galvanized iron conduits, which extend the whole length of each of the living spaces. From these mains, numerous branch lines extend athwartship. The foul air is carried off either by exhausting fans or by means of uptakes and ventilators. Steam coils are provided in the conduits by which the air can be warmed, as required, in the winter.

The distribution of officers and men and supplies in two of the latest and best of the transports, the "Kilpatrick" and the "Buford," is as follows: The hold is devoted entirely to freight; the orlop deck above the hold contains the refrigerators and storerooms; the between deck is given up entirely to sleeping accommodation; the main deck contains two separate lavatories, two separate mess decks, and sleeping accommodation. The spar deck contains the hospital, officers' staterooms amidships, and spaces for the promenading and recreation of the troops; while the promenade deck contains other staterooms and is reserved entirely for the use of the officers.

One of our illustrations shows the sleeping accommodation on the between decks. The bunks are arranged in tiers of three. They are of a type which has been designed with a special view to ventilation and cleanliness. It was found that it was absolutely impossible to use the old mattress bunk, and at the same time keep the sleeping accommodations free from vermin. Moreover, in the hot and muggy atmosphere of the tropics the mattresses were stuffy and uncomfortable. The standard type of bunk herewith illustrated is known as the Lane-Irwine. It is carried on four standees of 1½-inch gas-pipe. The bed proper consists of a stout piece of canvas laced into a gas-pipe frame, the frame being in turn laced to the sides of the bunk. These bunks have been found cool and comfortable in the tropics, and they have the great advantage that the canvas bottom can be unlaced and washed. In the hospital the beds are, of course, provided with mattresses, and they are arranged only two deep. The floor, moreover, is carpeted with linoleum, and other measures are taken to provide special comfort. The mess deck is provided with tables and benches with folding legs, which are so constructed that they can be folded into a very small space and stacked away in racks at the side of the deck, leaving, as shown in our illustration, a large open space for promenading and recreation. The refitting of the transports necessitates the thorough overhauling of the plumbing and piping, and the provision of many thousands of feet of new lines. Much of this new piping is of copper and brass, and the lavatory fittings are of solid porcelain instead of porcelain-lined ware, which is found to give only indifferent service. By the time the transport has been thoroughly renovated and refitted the cost has run up to a pretty high figure, not far short, indeed, in the largest vessels, of half a million dollars, the actual cost of refitting the "Buford" at Newport News being $397,637, while the cost of refitting the "Kilpatrick" at the docks of the J. N. Robins Shipbuilding Company, of New York, was $408,000.

It is the aim of the Quartermaster's Department to run transports, if possible, with a full load of freight. Some of the larger vessels carry as much as 2,000 tons of cargo, in addition to a complement of 1,900 officers and men. It has been found that if the ship has a full complement and full cargo, transportation can be carried on very much cheaper by the Quartermaster's Department than it can be by shipping troops and supplies by the various steamship companies. Thus, one voyage of the "Crook" from New York to San Juan and return cost $9,761.39, whereas the cost estimated at the current rates of civil lines of steamships would have been $19,907, a saving of $10,145.61. Another voyage of the "Crook" from New York to San Juan and back would have cost $26,419.29 had the men and supplies been carried upon regular lines, whereas the actual cost by the transport was $14,062.94, a saving of $12,356.35. It is the opinion of Major Carroll A. Devol, the general superintendent of the Army Transport Service, to whom we are indebted for our illustrations and particulars, that although good results, as shown by these figures, are being obtained under the present system of purchase and reconstruction of ships, even better economy could be realized if the department

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were to design its own ships and embody in them all the experience which has been gathered in the Spanish and Philippine wars. In conclusion, we are glad to be able to state that letters have been received by Major Devol from both officers and men on their arrival at Manila, stating that the system of accommodation as carried out on our transports is very successful, and that the spaces devoted to sleeping accommodations for the men had, indeed, been found to be, in the tropics at least, the best ventilated and most comfortable portions of the ship.

Automobile News.

After a two-year struggle with Chicago's bad streets the Illinois Electric Vehicle Company, operating a hundred auto cabs, has decided to go out of existence. Word to the effect that the directors of the cab company would recommend the winding up of the company early next month was given out. The directors say that at the present time Chicago is not ready for modern improvements in the way of electric cabs.

The road which has been in construction for some time past in Madagascar, from Tananarive to the coast, has recently been finished, and this will give a new impetus to affairs in the colony, especially in the matter of transportation, as formerly all the goods brought to the capital were taken across the country by native carriers. The opening of the road will no doubt be followed by the use of the bicycle and the automobile. A number of different transportation enterprises are now on foot, and several of these are to use automobile systems. It may be remarked that the last 40 miles of the road, which was laid through the forest, was finished in the space of three months by a force of 25,000 men.

The London Electric Omnibus Company, in its last council meeting, decided to adopt an electric omnibus system in preference to traction by electric tramway. The report concludes by demanding of the stockholders the amount necessary for the construction of three hundred omnibuses of small pattern, the price of each being estimated at $2,200. The total of $660,000 thus furnished will equip the system on a large scale. London is thus taking the lead in the question of electric omnibus traction, following the example of Berlin, the only city of Europe where the electric omnibus has come into use to any extent. The latter, it will be remembered, have been constructed by Siemens & Halske, and work with accumulators in most of the streets, using the trolley wire when they pass along the line of the tramway.

A number of automobile tours are being organized for the coming season. Among these may be mentioned the tours of England, Italy, and Belgium. The tour of Belgium, as organized by the Automobile Club, will consist of seven stages; it is to be held in the latter part of July. The seven days of the tour include the following routes: First day, Brussels—Malines—Antwerp, 26 miles; second day, Antwerp—Liège, 75 miles; third day, Liège—Spa, 30 miles; fourth day, Spa—Namur, 45 miles; fifth day, Namur—Charleroi, 25 miles; sixth day, Charleroi—Ghent, 66 miles; seventh day, Ghent—Ostend, *via* Bruges, 35 miles. The prizes will include gold, silver, and bronze medals, besides a prize of $800. At Ostend, the terminal point of the excursion, will be organized a series of races, as well as an automobile exposition.

The Automobile Club of France has finally decided upon the three champions who are to represent it in the International Cup race. These are Charron, Levegh and Girardot. Charron won the cup last year, and has besides made many notable records. In 1897 he won the Paris-Dieppe race, and in 1898 the Paris-Bordeaux over René de Knyff; he also gained the Paris-Amsterdam race of that year. In 1899 he was victor in the Paris-Bordeaux race, and made the record in two stages of the Tour de France. Last year he was second to René de Knyff in the Nice-Marseilles race, but won the Gordon Bennett Cup over the latter and Girardot.. It will thus be seen that his career has been a successful one. Levegh commenced to make his record in 1898 in the Paris-Amsterdam race, where he was seventh, but in 1899, with a four-cylinder machine, he won the last stage of the Tour de France, from Nantes to Cobourg. Shortly after he came out first in the Bordeaux-Biarritz race. In September, 1899; he made a dead heat with Girardot for the first place in the Paris-Ostend, beating Charron and Lemaitre, and in the Paris-Boulogne was second to Girardot. Last year he won the coast race, Nice-Turbie, and the mile dash at Nice, and carried off the honors in the Paris-Toulouse, the great race of the year. Girardot was called for a long time the "eternal second," as, in fact, he was second in most of the 1898-1899 races. He carried off his first victory in the Paris-Ostend, and then in the Paris-Boulogne, after having been second in the Tour de France and the Paris-Amsterdam. He won the Périgord Cup and was second in the International Cup race. It will be seen that the Automobile Club has made a wise choice of the defenders of the cup for this year.

Correspondence.

The New Armored Cruisers.

To the Editor of the SCIENTIFIC AMERICAN:

During the past few years I have been greatly interested in naval matters, and of late I have been particularly interested in the correspondence relative to our new armored cruisers of the "California" and "Maryland" types which has been published in your issues of February 9 and 16 and March 2. It would certainly seem that, in view of their great size, these ships are deplorably weak in battery power. To remedy this defect, your correspondents have suggested the addition of four 8-inch guns to their present battery of four 8-inch and fourteen 6-inch rapid-firers. While the adoption of this plan would successfully overcome their inferiority in offensive power, it would also necessitate the entire re-arrangement of their 6-inch and secondary batteries, with the possible sacrifice of some of the 3-inch rapid-fire guns. This would occasion a re-apportionment of weights and changes in design which. on consideration of the fact that the contracts for these ships are already (or about to be) signed, might be undesirable.

Would it not be a better and simpler plan to substitute 7-inch rapid-fire guns in place of the 6-inch rapid-firers? This would involve slight modifications in the gun positions, a reduction in the number of rounds of ammunition per gun, and an increase in the total displacement of the ship, but the enormous increase in muzzle energy would more than offset these inconveniences. Although there is no 7-inch gun in existence in our navy at present, I notice by your issue of December 22, that there is an experimental gun in process of construction. As it will be two years and a half before the batteries can be installed on these new cruisers, there will be ample time for the Bureau of Ordnance to ascertain the merits of this gun by practical tests, and commence the construction of others.

The details of the 7-inch gun are unknown to the writer, but it would not be unfair, it seems to me, to assume that its projectile will weigh about 175 pounds, and that the combined weight of gun and mount will not exceed that of the 6-inch gun by more than 10 tons. These dimensions are adopted arbitrarily as a result of observing the data of the 7.5 Vickers-Maxim rapid-fire gun, a description of which was published in your issue of January 12. On our new cruisers, 140 tons is allowed for the 6-inch ammunition supply, at the rate of 200 rounds per gun. Thus, the substitution of 7-inch rapid-firers for the present battery of 6-inchers, with the reduction of the ammunition supply to 150 rounds per gun, would make an increase of about 44 tons in weight of ammunition, and 140 tons in the weight of the guns and mounts, or 184 tons in all, a comparatively small item in a 13,800-ton ship. Also, a gun firing a 175 pound projectile at a velocity of 2,900 foot-seconds, or more, would be as much superior to the 6-inch gun as the 6-inch rifle is to the 5-inch, both in penetrative and destructive power.

There is no cruiser afloat to-day which could stand up before the tremendous amount of energy concentrated in a battery of four 8-inch and fourteen 7-inch rapid-firers, and even the new Italian ships (whose design calls for a battery of twelve 8-inch rapid-firers) would find their match in the "California." At some time in the near future, the many improvements in the resisting qualities of armor of moderate thickness will render the 6-inch weapon useless at the ordinary battle ranges. Indeed, I understand that it is with a view of meeting such a contingency that the 7-inch and 7.5-inch guns have been designed. Why, then, do we not follow the principles of the old maxim, "An ounce of prevention is worth a pound of cure," by forestalling the contingency? Why do we not hold true to our traditions of the War of 1812 by placing our new cruisers in the same relative positions as our famous old frigates which carried 24-pounders where their opponents carried 18's? Why, in the name of common sense, do we not build ships which will carry heavier batteries than those of 4,000 or 6,000 tons less displacement which were designed three or four years ago? If fighting is the primary object of a warship, it would certainly seem that her offensive power should not be made of secondary importance to other qualities in her make-up.

Your correspondents complain, and justly, that a deplorable deficiency in offensive power is also to be found in the semi-armored cruisers of the "St. Louis" type. Could not their defect be remedied in the same manner as that suggested for the "California" and "Maryland" types? It is earnestly to be hoped that our naval constructors will see fit to bring these fine ships up to the superior standard of excellence which they have attained in the latest battleships.

The events of the last three years have heightened public interest in the navy to an unusual degree, and I am sure that a large number of your readers are keenly interested in the naval information which appears in such generous quantities in your columns.

PAUL D. EMMONS.

East Boston, Mass.

Engineering Notes.

A controversy over the asphalt lakes in Venezuela has been adjusted and the case will be heard in the local courts.

The Metropolitan and District Railways of London have suffered severely owing to the competition of the omnibuses and the Central London Railway. They have been losing at the rate of $7,000 a week for the last half year, and the District Railway has decided to adopt electric traction. The change can be effected at a moderate cost and in a short time. The directors have been given full power to raise additional capital.

There was a substantial increase in the traffic through the Suez Canal in 1899. Three thousand five hundred and three vessels passed through the canal in 1898; in 1899 the number was increased to 3,607, representing an increase of 104 vessels and a gain of 657,017 tons. The average time consumed in passing through the canal in 1899 was eighteen hours and thirty-eight minutes, about half an hour longer than was necessary during the previous year.

The consumption of ice in Brazil is constantly increasing. This is due principally to the demand for ice in restaurants, hotels and other public places. Foreigners are most insistent in their calls for ice. Our consul at Santos is of the opinion that an ice company would prove a profitable undertaking in that place, the use of ice being practically unknown in the fish, vegetable and meat markets. He also thinks the American refrigerator would sell well in Brazil.

The first stone bridge with ring stones built in the United States is claimed by the town of Ipswich, Mass. It was built by the town and county in 1764. The builder was Col. John Choate. There are two spans, each of 28 feet. When the time drew near for the falsework to be removed the inhabitants of the town became greatly excited, and people thought it would not stand its own weight. Col. Choate had his horse ready to take him out of the country if the bridge fell. The falsework was successfully removed, however, and the bridge still stands, although it trembles a little with a heavy team. It was widened in 1838.

It is proposed to renovate London Bridge at a cost of $500,000. The footways are to be widened from their present width of nine feet to fourteen feet. A new granite corbeling is to be provided; the parapet will be reconstructed upon an open design so that the dust may escape into the river below; and the center of the bridge is to be brilliantly illuminated. The question arose as to whether the existing foundations of the structure would be sufficiently strong to support the suggested additions, but the report of Sir Benjamin Baker, who made a careful survey of the bridge, is affirmative. It is proposed to carry out the work immediately. When the Tower Bridge was opened, it was generally considered that the new means of communication between the north and south sides of the river would considerably relieve the stress of traffic over London Bridge, but the decrease in the traffic over the latter bridge is scarcely appreciable.

A new English port of call is to be established at Dover for the transatlantic liners plying between New York, Germany and Holland. The scheme has been in embryo for several years, but the construction of necessary accommodation for the vessels, in which the port is at present deficient, would have entailed such a heavy expenditure that it was abandoned. Since the Admiralty Department commenced operations upon an immense national harbor, the contract for which amounts to $20,000,000; and have notified the municipal authorities that the Admiralty pier, which is at present used as a landing stage for the steamers plying across the Channel, will be required for national purposes; and that there was considerable danger of the shipping trade of Dover being transferred to another port containing better accommodation, it has been decided to carry out immediately the construction of docks, piers, warehouses, etc. A new pier for the berthing of the steamers is to be erected and will be completed in about four and a half years' time. It will extend parallel with the present Admiralty pier, and will be 1,600 feet in length, and 350 feet in width. There will be eight sets of railway tracks to provide accommodation for ten or twelve trains at a time, and there will also be four landing stages for the steamers. The pier for its entire length will be covered, thus converting it into an immense railway station. The building of this part of the work alone will amount to $1,110,000. A pier has just been completed at a cost of $2,750,000. An extensive commercial dock with quay space extending to 14 acres, which is in course of construction, and which will provide berthing accommodation for vessels of the proportions of the "Oceanic," will cost $6,250,000.

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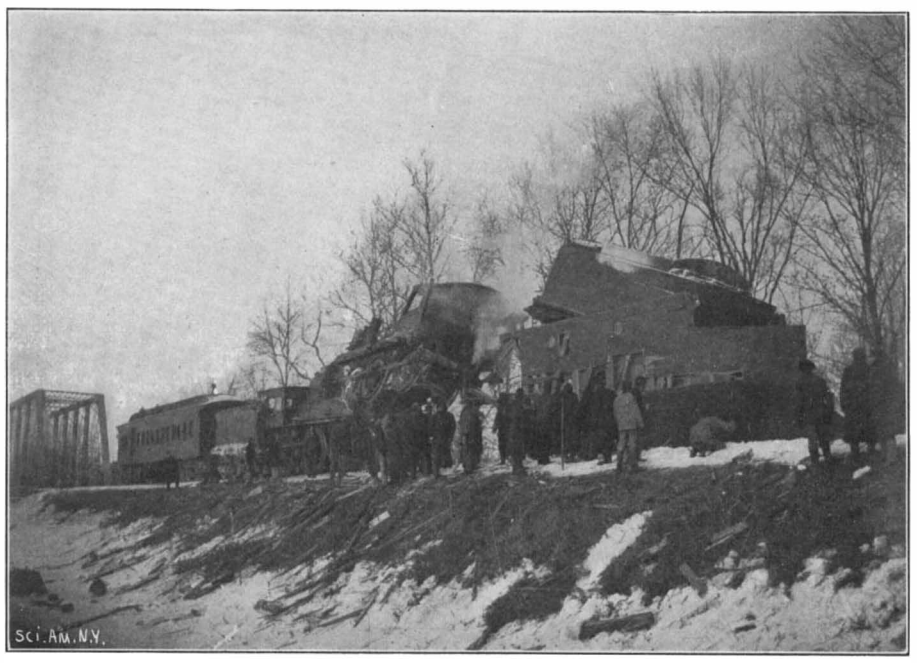
A PECULIAR RAILROAD ACCIDENT.

Unfortunately, railroad accidents are not of great rarity in the United States. One of the most peculiar accidents which has occurred in some time took place at White Pigeon, Mich., February 23, on an embankment on the main line of the Lake Shore and Michigan Southern Railway, close to a junction. An engine pushing a snow-plow came into collision with a freight engine standing still, and the snow-plow ran under the locomotive of the freight train, which rose in the air and landed on top of the other engine pushing the plow, as shown in our engraving. Two trainmen riding on the top of the plow were killed, and the engineer of the engine which landed on top escaped unhurt. The fireman also jumped, and escaped with slight bruises.



WRECK OF TWO ENGINES AND A SNOW-PLOW, WHITE PIGEON, MICH.

THREE CHARACTERISTIC TYPES OF AMERICAN DINOSAURS.

BY J. CARTER BEARD.

THEIR EVOLUTION.

Modifications in the structure of animals, fitting them to procure with the least possible difficulty the food upon which they subsist, afford unfailing keys to the history of the development and character of their environments.

Selecting an extreme case for illustration, the tardigrades, the gradual change in the surroundings of the tribe can be readily enough reasoned out in the transformation of one branch of the phyllophagous bruta, the enormous megatheriods, with their peculiar conformation, allowing them to sit upright, kangaroo-like, and reach from the earth, pull down and devour the foliage of the trees, to animals measuring less than three feet in length, the sloths, with radically different methods of procuring the same kind of food. So perfectly have the latter become fitted to a leaf-eating, arboreal life; so complete is the adaptation of the sloth to the nature and habit of growth in the trees in which it lives, that its organism, in its entirety and in every least part, demands a vast primeval forest of many-branched trees where the animal can pass its whole life, migrating from one contiguous bough to another, in search of fresh food supplies, without having any more cause to feel its deficiency in not being able to progress over the ground, to which it need never descend, than the seal or the dolphin in not being able to range over field and forest.

The reverse of this rule is obviously true. The more perfectly we become acquainted with the nature of the food supplies of any species or of any race of animals, the more unfailingly we can trace the evolution and describe the development of the type which forms the subject of investigation. A remarkable uniformity is observable in the conformation of the great terrestrial reptiles of the Mesozoic era. Its character reminds us, in a general way, of the plan of structure of the megatherium, insomuch as the comparative weight and strength and development of the hind quarters of the great reptiles afford absolute proof that they also must have sat upright, tripod fashion, supported by their hind legs and powerful and massive tails.

In the case of the megatherium, it is quite possible that the peculiarities of its structure point to the selection of some particular sort of vegetation. Mr. Woodbine Parish thought it was the agave, or American aloe, upon which it fed, but in the case of the dinosaurs there was no alternative.

The sparsely-branched and columnar forms of vegetable growth which afford little accommodation to arboreal animals consisted principally of Gymnosperms, especially of Cyads, which at this period reached their highest development, mingled with palms, tree ferns, many species of Filicinæ of lesser size, giant equisetums, liverworts, club mosses, and some herbaceous and some aquatic plants. The straight, upright shafts of the larger forms of plant life arose from the naked soil, for grasses had not yet clothed the earth.

Almost the only food supply the vegetable world afforded was the leaves, shoots, and young twigs of such trees as then grew, and to reach these required the great stature and peculiar build of the herbivorous dinosaurs.

The bipedal habit acquired by browsing upon the tall vegetation also gave them an extended range of vision, and to some extent insured their safety against the stealthy and undetected approach of enemies, principal among which was probably the large carnivorous dinosaur shown in our illustration, Ceratosaurus nascicornus, which reached a length of twenty-two feet. By assuming an upright position, this and other dinosaurs were, it is likely, sometimes able to elude their prey.

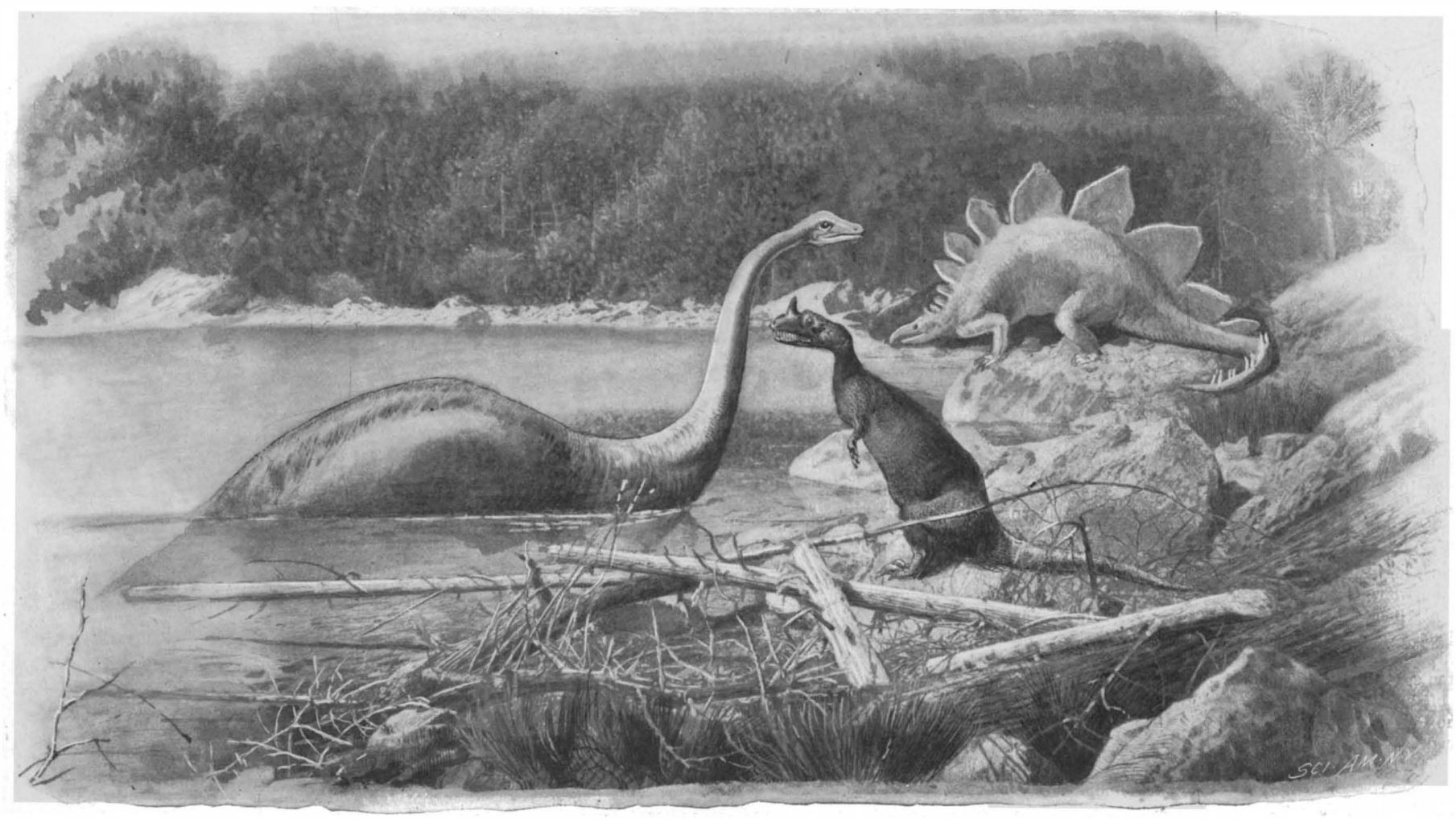
DESCRIPTION OF THE THREE TYPES.

Largest of all quadrupeds that ever trod the earth, the enormous brontosaurus, which reached the length of from sixty to perhaps seventy feet, and certainly weighed more than twenty tons, presents one of the most perplexing problems ever offered the paleontologist. How such an immense mass of almost brainless living flesh, with, so far as is known, no means of defense or refuge of escape, except taking to the water, in which he could be followed by powerful, agile, and more intelligent foes, escaped almost immediate extinction passes conjecture. How such an animal could stand upright upon dry land, under the terrible stress and pull of gravitation, which would put to the severest test the strength of cohesion of the mere flesh, muscle and bone of which he was built, is a question not easily answered. Paleontologists have lately been inclined to believe that the brontosaurus never came ashore, but an animal with four well-developed legs and feet formed for walking seems scarcely built for an exclusively aquatic life, and nothing that is known in natural history affords a parallel for such a state of things. The great beast, with its great body, long neck and disproportionately small head, is in the water at the left of the illustration.

Nearer to the foreground on shore is seen the great horned dinosaur, Ceratosaurus nascicornus, dwarfed in appearance here by comparison with the much larger brontosaurus beyond him. Small as he looks, however—and must look, to be in proper proportion to his companion—he measures no less than twenty-two feet, a rather formidable size for such a beast of prey. In addition to the large and trenchant array of teeth with which his massive jaws are furnished, he bears a stout horn, like that of a rhinoceros, projecting from a space just above his nostrils, and which must have added materially to his powers of offense and of defense.

The fore limbs are extremely small, it will be noticed, in proportion to the rest of the animal, and could never have been used for support, though they might have been of assistance to the ceratosarus in retaining a hold upon his prey. The animal must, in progressing, have always walked upright, dragging his massive tail behind him.

But, without doubt, the strangest animal ever known to have existed upon the face of the earth is the gigantic armored dinosaur shown somewhat in the distance upon the bank of the lake in our picture. This is the



THREE CHARACTERISTIC TYPES OF AMERICAN DINOSAURS.

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Stegosaurus ungulatus. The entire length of this dinosaur was thirty feet or more. The stegosaurus, instead of being entirely defenseless like the immense brontosaur described above, was provided not only with a complete osseous dermal covering, but with a series of large, erect, bony plates, protected by a thick, horny covering, extending along the back and part of the tail, and further to the end of the tail by four pairs of spines of great size and power.

We are, in this animal, confronted with a strange reversal of the first and governing principle of construction common to all modern vertebrates. An enlargement of the spinal cord in the pelvic region, giving a reinforcement of nervous power to the generally disproportionately large hinder half of dinosaurs, is in a number of species quite apparent, but in the stegosaurs the development of the lumbar region takes complete precedence of the fore part of the animal. The head—so diminutive in proportion to the entire bulk of this colossal reptile that it becomes a problem how a sufficient amount of food to sustain and nourish the enormous body could have passed through the jaws—contained a brain which, taking the proportional size of the two creatures into consideration, was one hundred times smaller than that of an alligator; but, as is well known, a second brain, twenty times greater than that contained in the skull, found place in the sacral cavity, and governed and intelligently directed the movements of the hind limbs and the armed tail of the monster.

THE NEW STREET RAILWAY TUNNEL UNDER BOSTON HARBOR.

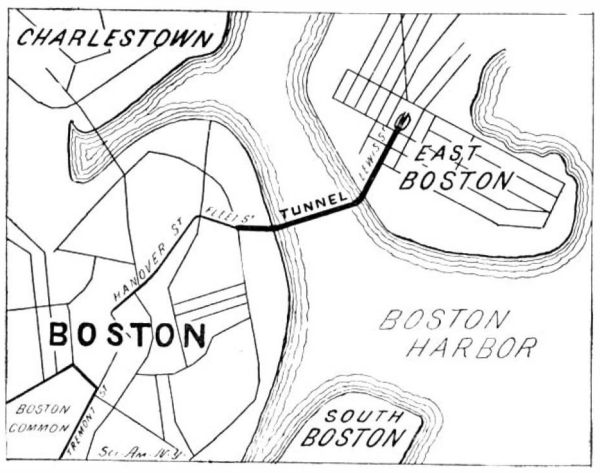
BY J. A. STEWART.

Street railway expansion has been going on rapidly in Boston by underground, elevated, and surface lines. Its latest and most interesting development is the new tunnel under the harbor from the South Ferry, on Atlantic Avenue, to the peninsular district known as East Boston.

When the Boston subway was built a few years ago, it was suggested that it would prove but the beginning of a network of subterranean avenues which would underlie the entire city—a statement which recent movements seem to have justified.

The legislative act of 1894, which authorized the people of Boston to appoint a Transit Commission to construct a subway under Boylston, Tremont and various streets in the north part of the city to the Union Station, also empowered that body to build the tunnel under the harbor to East Boston.

Work on the construction was begun May 5, 1900. The portion of the work then commenced—in Maverick Square and Lewis Street, East Boston—was not difficult of construction. The engineering problems, as the work could be in open cut, were of an ordinary nature. The excavating for the incline in Maverick Square was done without timbering the trench, and the earth was shoveled into carts. The sidewalls of the incline are of concrete, faced with granite and surmounted by a granite coping. Granite also surrounds the portal. The subway or covered portion of this section is a concrete monolith. Nuts and washers are embedded in the masonry to admit of the use of steel tie-rods for increasing the strength of the roof, if deemed desirable. The grade is 5 per cent, and the bottom of the masonry invert is about 39 feet below the surface of the street.



MAP OF BOSTON, SHOWING LOCATION OF TUNNEL.

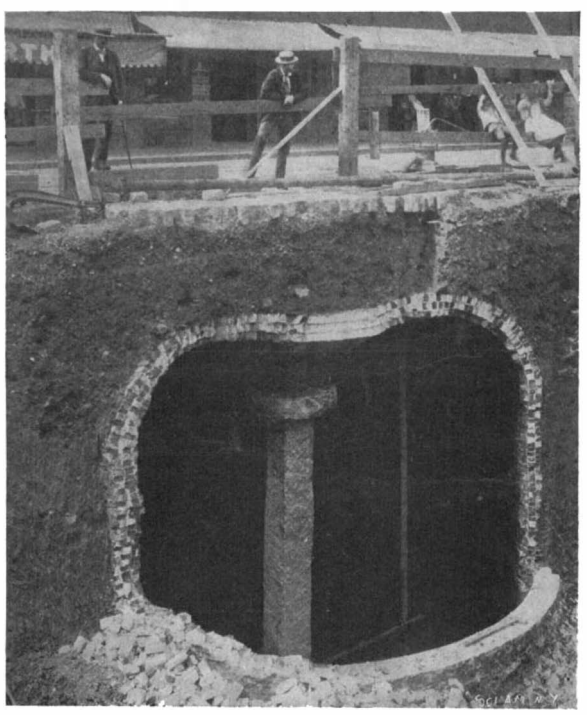
In preparing to put in place the masonry for the covered portion, the bottom of the excavation was graded, and three thicknesses of tarred felt were laid. They were thoroughly pitched together, and when the pitch had hardened, the concrete invert was put in and 6-inch back walls were carried up a convenient distance, the sheeting being removed and the trench rebraced as was necessary. The back walls were plastered with a rich Portland cement plaster, and against this the main wall was built. Wooden centers were used, and work on each section of the concrete arch was carried on continuously until its completion. Beginning in Maverick Square, the East Boston tunnel runs under Lewis Street, Boston Harbor, and, on the Boston side, under Eastern Avenue, Fleet and Hanover Streets, to Friend Street, where it connects with the subway system. The tunnel proper lies between the two South Ferry slips, a distance of about 2,250 feet.

In considering the important question of construction, the Commission was greatly aided by the experience of foreign cities as personally investigated by Chief Engineer Carson. Cast-iron twin tubes, of 10 to 12 feet in diameter, are used in the Glasgow street railway tunnels and in the London Underground Road, which passes under the Thames. Comparing the relative merits of twin tubes or a single wider tube, the Commission came to the conclusion that, although a wide tube would be more costly and would have less favorable grades than twin narrow ones, the wide tunnel would conduce more to the comfort of passengers, would be much more satisfactory to the public, and would be more in accordance with the work previously done by the city.

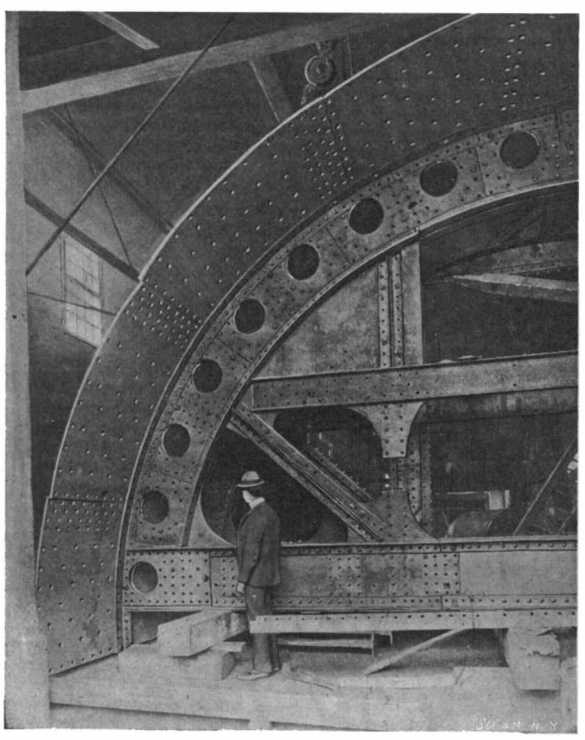
The Boston Harbor tunnel is an arched structure for two electric railway tracks. The thickness of the roof of earth over the outside of the arch of the tunnel under the harbor is from 16 to 18 feet. Above this, in the deepest part of the harbor, is 35½ feet of water at mean low tide. The tunnel under the harbor is about 20½ feet high inside; about 23 feet wide, and about 2,250 feet long. Its walls are 33 inches thick at minimum measurement.

The tunnel, on the East Boston side, has grades from 4.7 to 5 per cent. At a point 250 feet southwesterly from the Harbor Commissioners' line it is about 100 feet lower than in Maverick Square. A length of about 1,350 feet in mid harbor is nearly level. Short-length grades of 5 per cent occur on the Boston side, caused by the intervention of Commercial Street, where the east-bound platform is immediately below that for the west-bound cars, their depths below the street being respectively 66½ and 50 feet. There are pumpwells and chambers under the harbor.

In constructing the tunnel the shaft in Lewis Street was sunk to grade, and sidewalls were commenced in small tunnel drifts. A steel roof-shield spans these sidewalls and is pushed forward on them by means of hydraulic jacks. As the roof-shield is advanced step by step the arch is put in place inside. An air lock is built at a distance of 100 feet within the tunnel, by means of which air may be compressed to the degree necessary to prevent any objectionable flow of water into the working portion of the tunnel. A most interesting and important feature of the tunnel is its arrangement as to ventilation. In respect to good air, it is well known that the Boston underground system cannot be rivaled by any of its contemporaries. The City and South London Railway, 3½ miles long, consists of two cast iron tubes about 11 feet in diameter.



OLD RESERVOIR, UNEARTHED IN MAVERICK SQUARE.



A QUARTER SECTION OF THE EXCAVATING SHIELD.

APPROACH TO THE BOSTON TUNNEL, MAVERICK SQUARE.

THE MONOLITHIC, CONCRETE, ROOF OF THE TUNNEL.

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Through these tunnels, at an average depth of 50 feet, the cylindrical cars are run by electricity. Each small car pushes, piston-like, a column of air before it, the vacuum being supplied by fresh air from the rear. If it was not necessary to close the cars on account of the draught the arrangement would be completely satisfactory. But by reason of their small size the air within soon becomes impure though that in the tunnel is good.

The tunnel under the Mersey has two stations 80 feet underground and about a mile apart. Near each of these stations there are ventilating fans, which draw the vitiated air from the tunnel, fresh air to supply the requirement passing in through the stations. The tunnel, however, is traversed by steam cars, which render almost any system of ventilation practically ineffective.

In addition to the absence of steam and smoke the East Boston Tunnel has all the advantages of a scientific ventilation. Ventilating chambers are constructed on each side of the harbor. Ventilation is effected by a segmental duct of about 45 square feet area in the top of the tunnel. Near the middle of the harbor this duct communicates with the tunnel underneath by a door. The shore ends of the duct open into the ventilating chambers through which the air can be drawn out. The air enters from the open end of the tunnel in Maverick Square, and at or near the Commercial Street station it passes through the main body of the tunnel, enters the door in the duct, and returning to the shores is drawn out through the ventilating chambers.

The estimates place the cost of construction to the city at about $2,700,000. The work is in charge of Chief Engineer Howard A. Carson, who has already rendered the city excellent service as superintendent of its main drainage system, as engineer of the sewer systems of the Charles and Mystic Valleys, and in the Boston Subway work.

An Electric Lighting Board.

An ingenious system of electric lighting, called the "electric lighting board," has been recently patented by a company in London, by means of which it is possible to obtain a wide range of curious and novel lighting effects, quickly and cheaply, without involving the employment of any special appurtenances or necessitating any wiring. The lights may be also placed at any points, and can be removed to other portions of the board as frequently as may be desired without the slightest delay, and with the certainty that they will light up. The board to carry the lamps is covered with a face of cork and rubber. Beneath this substance is fixed a number of wires in a warp and embedded in asbestos. The lamp utilized is of the ordinary incandescent type, differing only in the fact that a specially milled shoulder is attached to cap and plug, from which project two sharp pins. To place the lamp in position it is only necessary to press these pins into the permeable coating of the board, and directly the pins touch the wires beneath the circuit is completed, and the lamp lights up. No fixing of the lamps in sockets is required, because a sufficiently strong hold can be effected by pressing the lamp into the rubber and cork. The numerous advantages accruing from this system will be readily recognized, since it dispenses with the employment of lamp holders, sockets, fixing, tapping, and so forth. Consequently the cost of material is greatly reduced, and no technical knowledge or skill is necessary in fixing the lamps. The presence of asbestos obviates all danger from combustion, which is liable by the formation of the arc caused through breaking the electrical circuit by displacing the lamps. It is also impossible, owing to the system of wiring adopted, to cause a short circuit. The electrical resistance is high. The purposes for which this system can be adapted are innumerable, especially in those installations where great illumination is desired, or the transpositions of the lights. On such a board words may be displayed in electric light and altered whenever desired. The system can also be used for filletings, mouldings, or other decorative purposes. It also lends itself to scenic effects upon the stage or for temporary lighting. The company have also completed experiments by which a narrow electric lighting flexible strip of any length is available for decorative or other purpose.

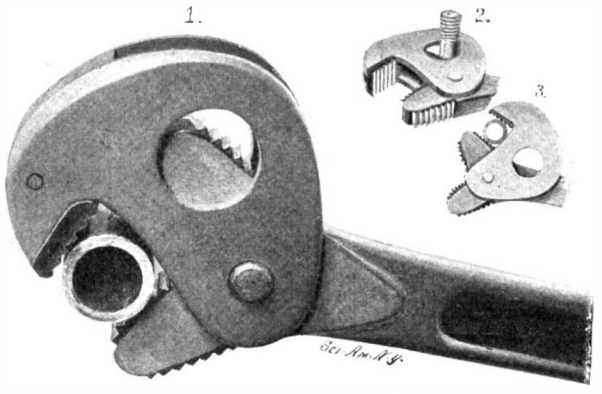
The American Geographical Society will move into its new building in 81st Street, New York, some time in May or June. The new structure is a very handsome one. There is no special assembly room, and the numerous lectures will be given in outside halls, as usual. A room capable of holding 300 persons has, however, been provided. The principal rooms are the reading room, the library and the parlors. The expenses for the new building are being paid out of a fund of $100,000 donated by Gen. Cullum and other contributors. The society has about 1,200 members. It was founded in 1852.

A NOVEL PIPE AND STUD WRENCH.

A recently-patented pipe and stud wrench invented by M. Z. Viau, of Malone, N. Y., is characterized by a novel construction which enables the jaws to grip a pipe or stud in various positions and to adapt themselves to pipes widely different in size.

As shown in our illustrations the end of the wrench-handle is formed with two toothed arms, between which a toothed movable jaw is pivoted, having an opening for the reception of a ⅝-inch stud.

The arrangement of parts is such that the movable jaw can be made to assume four positions relatively to the toothed arms and that a pipe can be gripped in any one of six positions of the movable jaw without reversing the jaw. The wrench automatically adjusts itself to the size of the pipe or stud. But one hand is necessary to operate the wrench, since by passing the pipe through the opening in the movable jaw the pipe



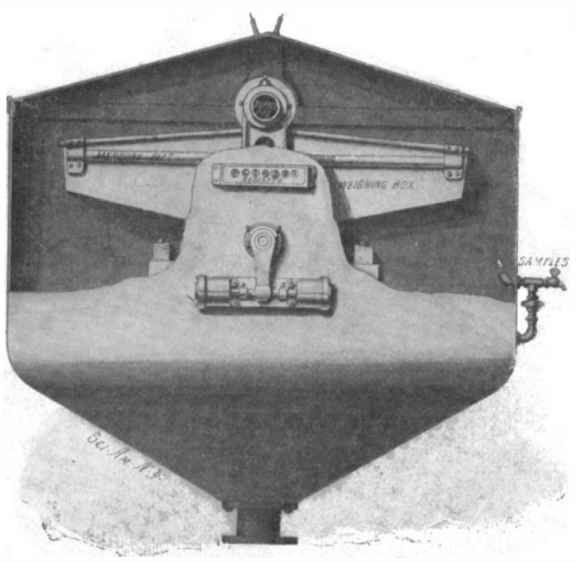
THE VIAU PIPE AND STUD WRENCH.

may be gripped simply by turning the wrench to one side or the other. Owing to the shape of the working face of the movable jaw the wrench can readily engage a pipe laid flat against a wall or floor.

AN AUTOMATIC WEIGHING-MACHINE FOR LIQUIDS.

In sugar making, before the losses in manufacture can be determined, the weight of the raw sugar must be known. A perfectly trustworthy and satisfactory method of weighing the sugar present in the cane would be of immense value in determining the losses in clarification, filtration and concentration, in boiling to grain and in curing, and in waste molasses. With losses ascertained, the undetermined loss in the raw sugar can be easily computed. And thus the sugar manufacturer can exactly determine what his loss may be and how it may be reduced to a minimum.

To measure these losses by volume is a method which is difficult and almost impracticable. For that reason Mr. Christian J. Hedeman, a Hawaiian inventor connected with the Honolulu Iron Works, has resorted to the simpler and more efficient method of weighing



THE HEDEMAN SUGAR-JUICE WEIGHING-MACHINE.

the raw juice, sirup or molasses. His machine has proved of such service on sugar plantations of the Hawaiian Islands, that it will be introduced into the United States by the Krajewski-Pesant Company, of 32 Broadway, New York city.

Mr. Hedeman's machine comprises a tilting tray divided into two compartments into which the juice to be weighed flows from a supply-pipe. Each compartment has an outlet which discharges into the casing or receptacle by which the device is inclosed. Extending longitudinally through the tray is a pipe partially filled with mercury, which serves as shifting weight to weigh off the juice and balance the tray. Two air-cylinders are located at opposite sides of the fulcrum of the tray; and in these cylinders are pistons connected by a stem actuated by the tray-trunnions.

The liquid runs into the compartment of the tray which happens to be uppermost. When the weight of the liquid is balanced by the mercury in the pipe, the tray is tilted by the additional liquid which flows into the compartment. So sensitive is the device that a very small additional amount of liquid suffices to tilt the tray. The filled compartment, then lowermost, discharges its contents, and the other compartment, now uppermost, is filled. The air-cylinders described prevent the tray from coming to rest with a heavy shock and do not operate until the partition between the compartments has passed the stream of liquid. Thus an error, due to friction, produced by pressure in the air cushions is avoided.

An automatic cut-off can be employed to make the machine even more accurate. And a register can be used to record the amount weighed. The machine can be very simply cleaned and adjusted and can be utilized in refineries, breweries, tanneries or distilleries for weighing liquid ranging in thickness from molasses to water.

Electrolytic Sugar.

M. Dupont made known to the Congress of Chemistry, which assembled on the occasion of the Exposition, says La Nature, the results of his researches upon the extraction of different sugars by electrolysis. The electrolyzer consists of a wooden trough divided into three compartments by porous partitions made of parchment paper or porcelain or asbestos. The electrodes consist of metallic plates that vary according to the object to be attained (platinum, aluminium, lead, zinc, etc.). A current of 15 volts, and of a density of from 25 to 30 amperes per square meter of anode is employed.

In order to obtain sugar from cane or beets, the saccharine juice is placed in the central compartment, and the end compartments are filled with water. Under the influence of the current, the albuminoid substances of the juice coagulate and precipitate, and the salts are decomposed. The juice becomes clear, limpid and colorless, and no longer contains anything but sugar and a few traces of organic matter plus a little lime and magnesia. By the term "sugar" is to be understood all kinds of sugar. There is no osmosis through the partitions. In the end compartments accumulate the soda, potassa and ammonia.

It is possible that the process studied by M. Dupont may be applicable industrially. The future will inform us as to that. But, however that may be, it is already very advantageous as a means of analysis. It permits, in fact, of rapidly searching for, isolating and making a quantitative analysis of the various sugars that may exist in a large number of plants.

A scientific party sent out by the United States Geological survey will travel by dog sledge over Alaskan ice bound for the Koyukuk River, 700 miles long and one of the two largest northern tributaries of the Yukon. Some miners in 1898 found pay dirt up this river on the gold belt that runs through Alaska. A large camp is there now, and the miners are doing well. Some distance below the mining camp the Altenkakat tributary joins the Koyukuk, and here a large supply of provisions was cached last summer for the use of the exploring party that is just starting out on its journey. This party is to travel from the mouth of the Altenkakat to the shores of the Arctic Ocean. It is a virgin field for explorers. The main purpose is to look for new gold fields, which, it is believed, may exist in the unknown region. The geology of the country will also be studied and geographic features delineated. The results are likely to be very interesting and valuable. D. J. Peters, of the Geological Survey, who will be the leader, left Washington last week for Seattle, whence he and his seven assistants will sail for Alaska.

The Current Supplement.

The current Supplement, No. 1316, opens with an article on "Automatic, Changeable Electric Signs," giving details of the Mason Monograms. "American Engineering Progress.—I—Present Conditions," is referred to elsewhere in this issue. "The Education of the Shipbuilder" is a paper by J. H. Biles. "The Manufacture of Starch from Potatoes and Cassava" is accompanied by a number of engravings. "Some Animals Exterminated During the Nineteenth Century" is an interesting article. "The Naval War Game" describes this very curious game. The usual "Trade Suggestions from United States Consuls" and "Trade Notes and Receipts" are published.

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RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

DRAFT-EQUALIZER.—JOHN RUSK, Cheneyville, Ill. The draft-equalizer is particularly adapted for use on gang-plows, and serves the purpose of equalizing the strain and avoiding side draft. The whiffletree is so mounted that the pivot is located between the ends. With one end of the whiffletree, draft devices are connected. A second whiffletree is employed, pivotally mounted at one of its ends. With the other end of the second whiffletree, draft devices are also connected. A connection is formed between an intermediate point on the second whiffletree and on the end of the first whiffletree opposite the end bearing the draft devices. By this arrangement, the draft is effectively equalized, and the vehicle or other implement moved regularly and without uneven strains on the team.

Engineering Improvements.

ROTARY ENGINE.—SIRUS E. KOCHENDARFER and RALPH D. HUNTER, Hollidaysburg, Pa. This improved rotary engine includes a casing having a cylinder in which an eccentric piston works. The steam-chamber has a way for the abutment-valve. Steam-passages communicate with the way at their opposite ends and with exhaust-ports. The steam-passages are controlled by valves. In its opposite faces, the abutment-blade is provided with recesses for the passage of the steam, and is arranged at its inner end to bear against the eccentric piston. Two pistons are employed, so arranged that before one reaches its exhausting-point, the other is being acted on by live steam. Hence, there is a constant steam action on the engine and a constant, positive operation of the shaft.

VALVE-GEARING AND REVERSIBLE VALVE.—FRANK M. KENNEDY, Clarendon, Ark. It has been the inventor's purpose to devise a reversible valve suitable for employment in oil regions, where simplicity of construction, ease of operation, and minimum expense of manufacture are essential features. The valve is reciprocated by a rod having rotary movement. A pinion is secured on the valve-rod, and engages the gear on the valve. The valve is rotated from its operative position, and transposes the steam and exhaust ports to coincide with the steam and exhaust ports of the cylinder, admitting steam for either motion. A reverse movement can be given to an engine instantaneously. The rotative movement of the slide-valve throttles the admission of steam into the cylinder, decreasing the air as desired, gaging and controlling the velocity.

Vehicle Appliances.

WAGON-BRAKE.—EDWARD L. MOORE, Sundance, Wyo. This brake is of simple construction, and can be readily applied to any wagon to act automatically while traveling down grades. The pressure of the brake on the wheels is regulated more or less by the degree of inclination and the load weight. When it is desired to back the vehicle, the brake is prevented from operating.

MOVABLE VEHICLE-SEAT.—JOHN C. LAMBERT, Tonica, Ill. It is the inventor's purpose to provide a third seat for one-seated vehicles, which is normally located in a central aperture in the main seat, but is so adjustable that it can be shifted in front of the main seat, opposite the aperture. Thus, a third passenger can be accommodated without crowding the other two occupants of the vehicle.

BICYCLE-FRAME MEMBER.—JAMES H. SUTHERLAND, Cairo, Egypt. This invention provides an improvement in forks for bicycles. Tubular lower members and tubular upper members comprise the fork. The upper members are semi-cylindrical. A clamping-crown or block engages the members at the lower side, and has collars at its ends to embrace the lower members of the forks. A sleeve engages the members at the bend, and has portions extended through the collars and then turned outward. A latch turns outwardly. By the method of fastening the members in the device as described, no brazing or soldering is necessary.

Mechanical Devices.

ADDING APPARATUS.—FREDERICK H. SANDHERR, St. Louis, Mo. Mr. Sandherr has invented an improvement in adding-machines having recording or printing devices co-operating with the printing device of a typewriter, and including in the embodiment a total mechanism. It therefore follows that the machine can be employed for ordinary writing, for ordinary adding, for tabulating the figures of addition and striking the total, and for producing the text, the tabulated figures, and the totals of such accounts as may be desired.

AUTOMATIC ORDNANCE OF LARGE CALIBER.—CONSTANTIN VON HANNEKEN, Berlin, Germany. The novel features of the invention are to be found in an ingenious arrangement of recoil and loading cylinders. When the gun has been fired and recoils, the piston of the recoil-cylinder is locked in place by a pawl, whereby the piece is prevented from returning to the firing position for the time being. The air compressed by the recoil-piston passes to a collecting-chamber, and is there imprisoned. In loading the gun, the collected compressed air is ad[illegible] simultaneously both to the loading cy[illegible]d recoil cylinder: but the recoil-pist[illegible] still locked by the pawl, the gun is held in the position into which it recoiled. When the loading-piston has reached the end of its stroke, and a projectile has been inserted in the breech, the pawl is automatically released, and the gun projected into battery by the pent air in the recoil-cylinder.

PIPE-WRENCH.—CHARLES M. INGERSOLL, Summithill, Pa. The purpose of the invention is to provide a wrench which will engage a pipe at opposite points and exert an equal strain to prevent the crushing of the metal. When the wrench is reversed to recover its hold on a pipe, the jaws yield slightly so that they may be moved loosely around the pipe without gripping.

TILE-MACHINE.—ALEXANDER H. MURRAY, Huntington, W. Va. Much difficulty has been experienced in the formation of fissures or cracks in the side edges of tiles, by reason of the fact that the clay is fed more rapidly at the center than at the sides of the mouth of the guide when discharged. To avoid this difficulty, the inventor has devised an improved means for regulating the feed of the clay, with minimum friction or resistance to its discharge from the guide. The novel feature of the invention is to be found in a tile guide or mold, having two or more retarders on opposite sides, the two sets having straight edges adjacent to the mouth.

STAMP-AFFIXING MACHINE.—ROBIE SEIDELINGER, Boston, Mass. By means of this machine, stamps are automatically separated from the strips and rapidly attached to envelops and wrappers. The stamps are supported and separated by plates which are elevated with the stamps in the casing. A series of fingers or pawls, spaced apart, engage the perforations of the stamped strips, and are operated to move the strips forward. A projected stamp is severed and the plates discharged one at a time.

Miscellaneous Inventions.

GAME.—CLARENCE W. TARBET, Pomeroy, Wash. The game is an improved form of billiards or pool. The board employed is four-sided and has a plane surface provided with pockets at its angles, and also with three spots for a like number of balls, which are distinguished, like the spots, by marks, as red, white, blue. A raised, flanged, and cushioned frame surrounds the board, and each of its four sides is divided into three sections marked to correspond with the spots and balls in regular succession, as red, white, blue. The three balls are placed on the three corresponding spots. A fourth or cue ball is used for playing upon any one of the spot balls, its place in beginning the game being anywhere back of a "dead line" drawn transversely across the board.

APPARATUS FOR PURIFYING WATER.—OTTO F. BEHREND, Erie, Pa. This purifying apparatus is especially adapted for refining the feed-water of boilers and thus preventing the formation of scale. The apparatus comprises a water-receiving tank, a chemical-solution tank, and a mixing-tank having an overflow-pipe leading out through its bottom. Pumps deliver the impure water and chemical solution to the mixing-tank. The impure water and chemical solution are mingled in the mixing tank by means of steam. Below the mixing-tank is a precipitating-tank having a central open-ended pipe, into which the overflow-pipe of the mixing-tank discharges. A pipe leads from the upper end of the precipitating-tank, and is provided with a sprinkler at its discharge end. The sprinkler discharges on a filtering-bed in a filtering-tank. Below the filtering-bed is an outlet-pipe.

TRAVELER FOR CURTAIN POLES.—JOHN H. HILLIKER, Manhattan, New York city. The traveler for curtain poles can be easily moved within the slot of the pole. The construction is such that any irregularities in the path of the traveler will not appreciably interfere with its progress. The body and head of the traveler are so arranged that the body is free to move in any direction while the head is at rest.

CUSHION FOR PACKING GOODS.—FRANK B. READ, Manhattan, New York city. The inventor has devised a cover to be used in packing fruit. The body of the cover or cushion is corrugated on both sides. A plane face extends over the corrugations on one side of the body, and a yielding pad on the side of the facing opposite that on which the corrugated body is situated. The cushion by its elasticity yields enough to prevent injury to the fruit by the pressure of the barrel-head, yet holds the fruit with sufficient firmness to prevent shaking and rattling.

EXTENSIBLE UMBRELLA-HANDLE.—PAUL P. I. FYFE, Concord, N. C. The handle can be adjustably secured upon the stick or rod of an umbrella or parasol and readily detached. The handle may contain a fan or similar article. When not in use, the umbrella or parasol can be conveniently supported. A receptacle can be attached to the handle, in which gloves or handkerchiefs can be carried so as to leave one hand free.

GATE.—OLAUS B. JACOBS, Roland, Iowa. The gate is a stock-gate provided with balancing and locking devices. Such is the construction, that the gate can be readily opened by persons walking or riding, and that certain parts can be adjusted to permit cattle to pass, and to bar the passage of hogs, sheep, or horses. The gate can be so adjusted that horses can be admitted to pass, but no small animals. Or, if it be so desired, small stock, such as calves, may pass through, but large stock restrained.

FENCE-POST.—PAUL P. I. FYFE, Concord, N. C. In this invention Mr. Fyfe has sought to provide a means whereby a fence-post having a screw-base can be forced into the ground either by hand or by a draft-animal. One of the features of the invention is the provision of a support and guide for the post while it is being placed in position, which guide and support can be readily applied to the post and quickly removed.

CAN-OPENER.—WILLIAM A. HUNTER, Oneonta, N. Y. This can-opener can be used to open polygonal or round cans, the head being cut out close to the sides or at any distance from the sides. A right or left hand cut can be made on a prescribed circle at any place in a can. The pivot-point of the device can be extended to accommodate the opener to large-sized cans.

RAILROAD-TICKET.—GEORGE W. CRAIG, Provo City, Utah. Mr. Craig's present invention is an improvement upon a ticket which he has already patented. In the former construction it was sought to provide a ticket-form available, by appropriate punch-marks, for travel between various points. The ticket-agent was able to give the passenger (with only one form of ticket) a choice of any of the routes available for the particular journey intended. The present invention has for its object mainly to facilitate the selection and designation of the railroad lines available, by grouping the names of the lines in the order in which they are used.

VENDING-TRAY.—FRANK B. CLAGGETT, Manhattan, New York city. Mr. Claggett's invention is a tray or receptacle for holding peanuts and for keeping them warm; and the object is to provide a simple means for drawing the nuts toward the outlet end of the tray or receptacle upon opening the cover. This object is attained by the employment of shafts extended across the tray or receptacle and provided with fingers. The shafts have connection with a swinging door, whereby they are rocked and then moved forward toward the opening of the tray.

Designs.

SOUNDING-TOY.—JAMES S. PATTEN, Room 400 Equitable Building, Baltimore, Md. The sounding-toy consists of a block or head of metal designed to be applied to the end of a cane and receive an explosive cap which may be exploded by striking the head against the pavement. The head is of a novel design, and includes a central seat for the cap and a number of lateral vents for the escape of the products of explosion, and also a tapering form of a cap seat with a countersunk upper wall to secure the ejection of the exploded cap by the force of the explosion.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

UEBER DIE ENTWICKELUNG DER EXAKTEN NATURWISSENSCHAFTEN IM 19. Jahrhundert. By J. H. van 't Hoff. Hamburg and Leipzig; Leopold Voss. 1900. Price 25 cents.

Physics and chemistry receive the largest share of Prof. van 't Hoff's attention, as was to be expected. While pointing out the fact that there is not always a clear line of demarkation between these two sciences, the author offers the very good definition that physics is the science of the transmutation of energy, while chemistry is the science of the transmutation of matter.

DIE ELEKTRICITAT. Eine kurze und verständliche Darstellung der Grundgesetze sowie der Anwendungen der Elektricität zur Kraftübertragung, Beleuchtung, Elektrometallurgie, Galvanoplastik, Telegraphie, Telephonie und im Signalwesen. Sechste Auflage. Vollständig neu bearbeitet von Dr. Alfred Ritter von Urbanitzky. Ehemals von Th. Schwartze, E. Japing und A. Wilke. 163 Illustrations. Vienna: A. Hartleben, 1900. Octavo. Pp. 160. Price 50 cents.

Dr. Urbanitzky seems to have given a very good elementary exposition of the various applications of electricity in modern industry. That the book has passed through six editions is in itself a sufficient recommendation.

PRACTICAL COAL MINING. A Manual for Managers, Under-Managers, Colliery Engineers, and Others. By George L. Kerr, M.E., M. Inst.Min.E. London: Charles Griffin & Company, Limited. Philadelphia: J. B. Lippincott Company. 1900. 520 figures and diagrams. Pp. 462. $4.

In the present volume English practice is, of course, described, but the author has produced a book which will surely be valuable even to mining engineers in our own country. The subject is adequately treated in all of its phases, and especial attention is given to such subjects as timbering, winding coal, haulage, pumping, ventilation, safety lamps, surface arrangements, coal cleaning, surveying, leveling, etc. The book is profusely illustrated by 529 engravings.

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Inquiry No. 198.—For machinery for making sawdust briquets for use as fuel.

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WATER WHEELS. Alcott & Co., Mt. Holly, N. J.

Inquiry No. 200.—For manufacturers of wagons and buggies.

Yankee Notions. Waterbury Button Co., Waterb'y, Ct.

Inquiry No. 201.—For manufacturers of plows.

Brass Cups, Threaded. Bliss Chester Co., Prov., R. I.

Inquiry No. 202.—For manufacturers of stoves.

Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St., Chagrin Falls, O.

Inquiry No. 203.—For manufacturers of tinware.

Rigs that Run. Hydrocarbon system. Write St. Louis Motor Carriage Co., St. Louis, Mo.

Inquiry No. 204.—For manufacturers of saddles and harness.

Ten days' trial given on Daus' Tip Top Duplicator. Felix Daus Duplicator Co., 5 Hanover St., N. Y. city.

Inquiry No. 205.—For a hand punch for iron work.

Wanted. Pan Am. Exposition Patent Novelties suitable for souvenirs. Address J. M. B., 320 B'way, N. Y.

Inquiry No. 206.—For manufacturers of steam core drills to be used in prospecting for coal.

Machinery designed and constructed. Gear cutting. The Garvin Machine Co., Spring and Varick Sts., N. Y.

Inquiry No. 207.—For manufacturers of electric light plants.

Saw-mill machinery and outfits manufactured by the Lane Mfg. Co., Montpelier, Vt.

Inquiry No. 208.—For metallic packing.

Guns and Sporting Goods. Keating Wheels. New catalogue out now. The H. & D. Folsom Arms Co., 314 Broadway, New York.

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Manufacturers of Automobiles can secure right quality engines and boilers. Write Rochester Cycle Manufacturing Co., Rochester, N. Y.

Inquiry No. 211.—For paper-bag manufacturers.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

Inquiry No. 212.—For cast steel castings for three-throw cranks for steam and gasoline engines.

The best book for electricians and beginners in electricity is "Experimental Science," by Geo. M. Hopkins. By mail, $4. Munn & Co., publishers, 361 Broadway, N. Y.

Inquiry No. 213.—For manufacturers of excelsior.

Wanted to Manufacture.—A machine shop with facilities for medium and heavy work, desires to secure some special machine to manufacture. Address Manufacturer, Box 773, New York.

Inquiry No. 214.—For paper-bag machinery.

Government Relics—guns, swords, revolvers, saddles, cannons, etc. from Goverment Auction are now being sold at ridiculously low prices. Send for illustrated lists. Francis Bannerman, 579 Broadway, N. Y.

Inquiry No. 215.—For small steam rollers for use on concrete, etc.

Wanted—Revolutionary Documents, Autograph Letters, Journals, Prints, Washington Portraits, Early American Illustrated Magazines. Correspondence Solicited. Address C. A. M, Box 773, New York.

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PROOF OF THE PUDDING.

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Inquiry No. 217.—For parties to make in quantities an operating table of wood and metal.

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Machine chain of all kinds. A. H. Bliss & Co. North Attleboro, Mass.

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Inquiry No. 220.—For aneroid barometers.

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Inquiry No. 222.—For the manufacturer of the "Norcross" separator or improved butter machines.

Inquiry No. 223.—For first-class duplex steam pumps.

Inquiry No. 224.—For steam engine boilers and double cylinder and compound engines for stationary and marine purposes.

Inquiry No. 225.—For apparatus for burning crude oil for boilers and melting-furnaces.

Inquiry No. 226.—For hydro extraction machines, desiccating apparatus, and apparatus for the separation of solids and liquids.

Inquiry No. 227.—For manufacturers of aluminium card cases.

Inquiry No. 228.—For large manufacturers of common lava and miscellaneous gas tips.

Inquiry No. 229.—For manufacturers of metal gas tips.

Inquiry No. 230.—For parties willing to make machinist's tools and other tools to order.

Inquiry No. 231.—For manufacturers of glass bottles such as are used in toilet sets, for holding toothbrushes, etc.

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Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(8125) C. D. M. writes: The sparking coil for my power boat is 9 inches long and wound with No. 12 wire. As it is supplied with two sets of small "Mesco" dry batteries of six each, and liable to "skip," I am of the opinion that I should either have more volume of current to saturate the coil or have the same wound with small wire to get the best results. Am I right? A. The cells of the battery may be exhausted and new ones may be needed. If this is not the case, a larger number of cells should be added. Probably another set of six would furnish enough current to make the spark sure. It would not be well to use finer wire on the coil. This would cut down the current by its greater resistance.

(8126) E. A. S. asks: 1. How high a frequency of explosion could reasonably be attained in a small gas engine, ignition to be by electric spark and the amount of gas small? A. There is a possibility of 1,200 explosions per minute in a 4-cycle engine giving 2,400 revolutions per minute. All gas engines cannot come up to this mark. Many small engines will not reach a third of this speed. 2. Could you refer me to any tables containing the relative force of explosion of different mixtures of gas and air? A. Tables of explosive mixtures of gas and air, with much information in regard to the operation of gas and gasoline engines, are contained in Hiscox's book on "Gas, Gasoline and Oil Vapor Engines," which we can furnish, $2.50, by mail.

(8127) J. M. F. asks: 1. Will you please answer me in your notes in the Scientific American if the motor Mr. Hopkins describes in the paper of December 8 and 15 can be run by a direct current of 110 volts? A. The little motor described in our issues of December 8 and 15 cannot be run by a current of 110 volts pressure. The diagrams show that four battery cells are to be used to run it. 2. Will you please print a full description of a battery volt-meter in next issue? A. Supplement 1215, price 10 cents, contains plans and instructions for making a volt-meter and am-meter.

(8128) F. F. asks: 1. Can you tell me how to join a transmitter and receiver on an extension bell so that every time the 'phone rang it would not be necessary to go to it, but be answered at the extension bell end? A. The extension bell, transmitter and receiver form a complete set in themselves. They should be set up at the place wanted and regularly connected to the line. Both bells will ring, and the call can be answered from either telephone. The line will be a party line of two stations. 2. I have a small dynamo which uses carbon brushes; it sparks at one of the brushes, and I cannot remedy it by shifting the brush. What had better be done to stop it? A. There are many causes of sparking at the commutators. Roughness of the bars is a common cause after the machine has run a long time. Poor contact from any cause is another. The remedy for these is obvious. Other causes may exist in broken coils or grounded coils or short circuits. These are fully discussed in Crocker's "Dynamo Tender's Handbook," price $1, by mail.

(8129) F. W. F. writes: I have a 110-volt alternating lighting circuit. I wish to use a motor that, in turn, will drive a dynamo of fifty 16-candle power lights, giving direct current of at least 110 volts. What horse power motor must I use? A. Six horse power in the motor should do the work, if the current is not to be carried to a distance.

(8130) O. H. B. asks: 1. Would wire No. 17, A. W. G., do for winding the field magnet of the motor illustrated on page 498 of "Experimental Science," the edition of 1890? A. Yes. 2. Why is not copper or steel used instead of platinum for the connection on a circuit breaker of an induction coil? A. Platinum neither melts nor oxidizes. 3. Would wire No. 17, A. W. G., or No. 19, A. W. G., be best to cover a U-shaped magnet composed of hoop iron ¼ inch thick and 6 inches long before it is bent into the U shape? The magnet is to be used on a telegraph instrument which is to be connected with another one-quarter of a mile away. How much wire would the magnet need to be wound with? How many, and how large, blue vitriol batteries are required? A. A finer wire would be better, say No. 24. Three hundred to four hundred feet will answer. 4. What is the principle on which a naphtha engine runs? A. The vapor of the naphtha, mixed with air, is exploded in the engine, and the pressure due to the explosion drives the engine.

(8131) R. C. F. asks: Will you kindly discuss, briefly, the time element in wireless telegraphy? By this may be meant how, if it be a form of sympathetic vibration, it is related, in the above particular, to the action of tuning forks or strings of the same pitch. Are we obliged on theory, as yet, to attach instantaneousness to it, as in the case of the action of gravitation? Is this same instantaneousness attachable also to the action of two magnets? Or are all these actions to be considered as motions through a medium, though not as yet measurable like that of light and electricity? A. The waves in wireless telegraphy are electro-magnetic waves, sent off from the wire of the transmitter and received upon the wire of the receiver. They require time for formation and propagation through space—a longer time than light requires. Fahie's "History of Wireless Telegraphy," price $2, by mail, will give you much information on this matter.

(8132) C. T. J. asks: Will telegraph instruments of different ohms resistance work together without using relays? If not, why? Please explain fully. A. If there is any considerable difference in the resistance of the receivers they will not work well in series on the same line. The current which will magnetize one will not be sufficient to magnetize another with fewer turns on its coil. The best arrangement is to use a local circuit at each station, as is done on regular lines. Then each receiver answers to its own battery, while the relays wound to the same resistance work the line.

(8133) C. A. M. writes: I want a book on electricity, one that gives the tables, per foot, in pounds, of different sized wire; also resistance in ohms of different sized wire, per foot or pound. A. The data for wire are to be found in "Arithmetic of Electricity," by Sloane, price $1, by mail.

(8134) T. E. P. asks: How much water per minute will run through 1,200 feet 5-8-inch horizontal pipe, under fifty feet head? A. Three gallons per minute.

(8135) M. L. L. asks: In order to settle a dispute, and due to the fact that the books of reference we have consulted do not contain the absolute facts, will you kindly advise whether the oxidizing of lead, tin and zinc produces more weight in oxide than the original metals weighed at the start? This, with the presumption that nothing else but heat is used for the purpose of making the oxides. We would also appreciate it very much if you can give us the exact increase, if any, that there is in weight by the making of oxides of these metals. A. Whatever weight of oxygen is used to convert the metal into an oxide is added to the weight of the metal when the whole is converted. Lead oxide is PbO. The combining weight of lead is 207; of oxygen, 16. Therefore, 207 ounces of lead will use 16 ounces of oxygen, and the lead oxide will weigh 223 ounces. Proceed in the same manner for all the other oxides. The combining weight of tin is 118, and of zinc is 65. The oxides of lead are PbO, Pb_2O, PbO_2. The oxides of tin are SnO, SnO_2, and Sn_2O_3. Zinc oxide is ZnO.

(8136) W. E. D. asks: Have you any Supplements describing the construction of a small hand camera, about 5 inches x 6 inches? What would be the cost of materials for such a camera? A. Supplements 826 and 1021, price 10 cents each, describe cameras. Supplement 625 describes the manner of making a bellows. The cost of material is very little, except for the lens, and the lens may cost all you care to put into it. As good a lens should be bought as can be afforded.

(8137) B. I. T. and others have heard the belt question argued for a quarter of a century—which side of a leather belt should run next the pulley, the grain or the flesh side. A. The grain side on the pulley is the most efficient, but appearance seems to have established the practice otherwise.

(8138) W. T. asks: Will you please let me know what material (I believe copper will not do) can be used in construction of an acetylene gas generator? Can rubber be used in joints of valves, etc? A. Tin will answer the purpose. Rubber or leather will answer for valves.

(8139) J. F. S. writes: In experimenting in the mixture of colored light produced by transmitting light through colored glass, I find that, using Heide's colored jujubes, green + orange = yellow; green + violet = blue; orange + violet = red; but, using colored glass instead of jujubes, the mixtures are like those of pigments. Why are not the results the same in both cases? A. The results are not the same because the lights used are not the same in the two experiments. To test the lights, we must pass them through a spectroscope. The eye cannot tell. Two lights which look the same to the eye are found to be very unlike when submitted to the analysis of a prism. Your experiments with the lights are by means of absorption. When one glass has taken all it can out of the light, you pass the rest through another glass. That absorbs what it can of the remainder, and you call that a mixing of colors. It is not a mixing of colors at all. If you would mix colors, place them so that the light from each shall combine in the eye, and observe the result. See Rood's "Modern Chromatics," price $2, by mail.

(8140) M. C. O'C. asks: Which is the best battery to use for medical purposes—dry cell or wet cell? Have you any book teaching a person how to use and apply it? A. A dry cell will work a medical coil as well as a wet cell. We can furnish you Bartholow's "Practical Treatise on Electricity in Its Application to Medicine," price $2.50 by mail. We must say that it is not safe to use electricity except under the advice of a competent physician, if one can be had. Your case may be an exception.

(8141) A. B. W. asks: Will you inform me the best kind of paper to use for the field plates of the Toepler-Holtz and similar machines? I understand they are sometimes put on the glass with shellac varnish, but should suppose this would be non-conducting when dry. Would not glue be better, which naturally absorbs some moisture from the air, especially when it is damp? A. It does not matter much what is used to fasten the paper disks to the glass plates of the Holtz machines, except that it must be something which will not gather moisture, but remain perfectly dry. Every part of this machine must be dry. Shellac is very good for the purpose. The paper is a non-conductor, and is intended to be so. The strips of tinfoil under the paper serve to connect with the brushes so that the charge produced by the brushes is carried over to act inductively on the plate.

(8142) J. F. C. asks: Please tell me if the relay used on the ocean cable is the same as that used on the common telegraph? If its object is to strengthen the current, would it add more power (however little) to a strong current produced by a generator? If not, why not? Could anything do so? A. A relay does not add anything to the current flowing through it. It cannot strengthen it in any way. It is a circuit closer for a local circuit, and acts as a switch to cut in the local battery and work the instruments by that current and not by the current which works the relay. An arrangement for strengthening a current is used to make up lost volts in a line for lights and power, and is called a "booster." It is a seperate generator at a voltage which replaces the loss to the line.

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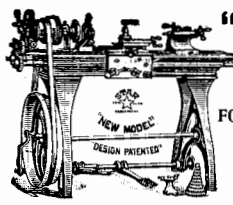

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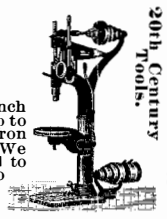

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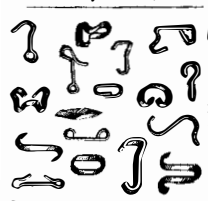

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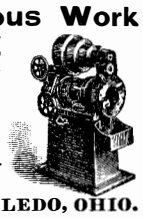

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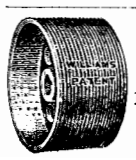

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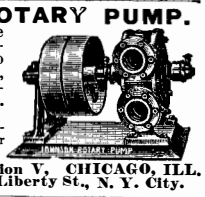

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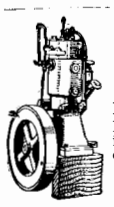

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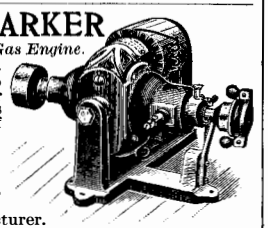

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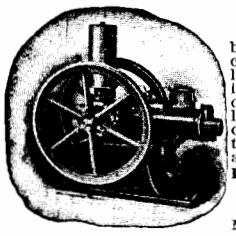

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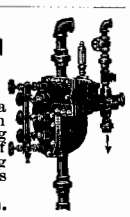

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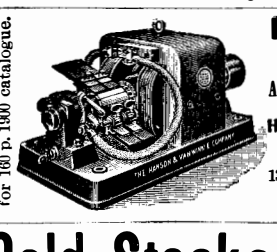

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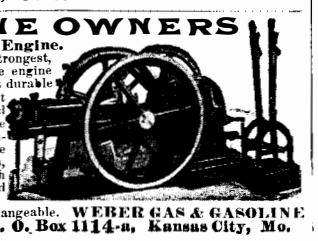

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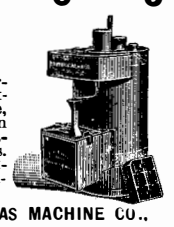

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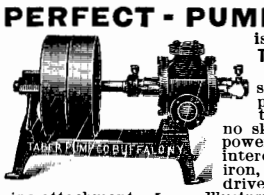

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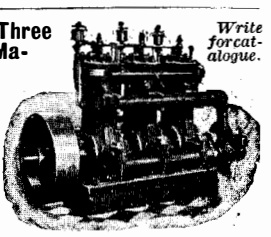

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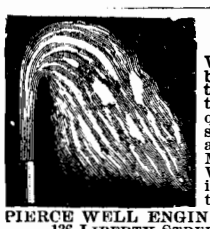

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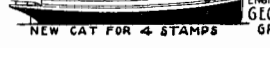

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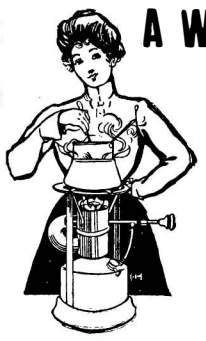

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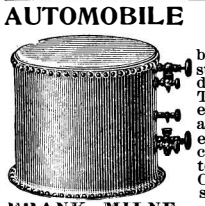

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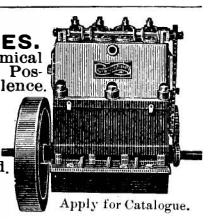

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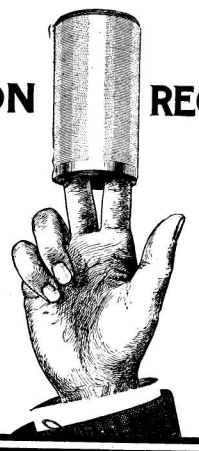

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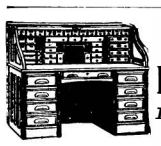

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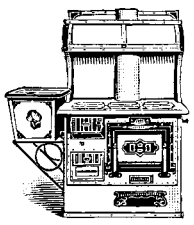

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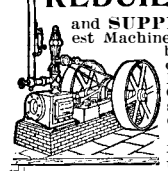

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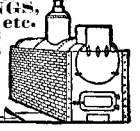

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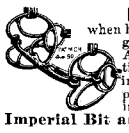

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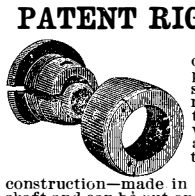

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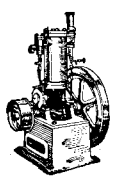

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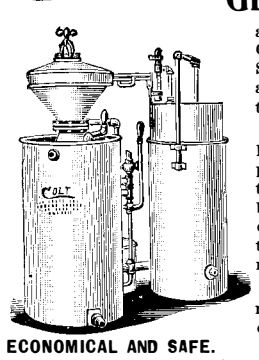

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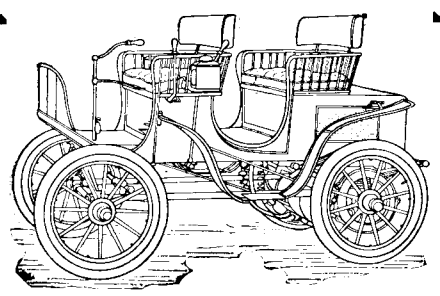

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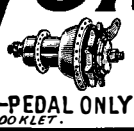

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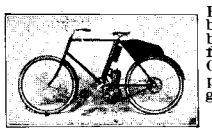

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